SCIENTIFIC AMERICAN

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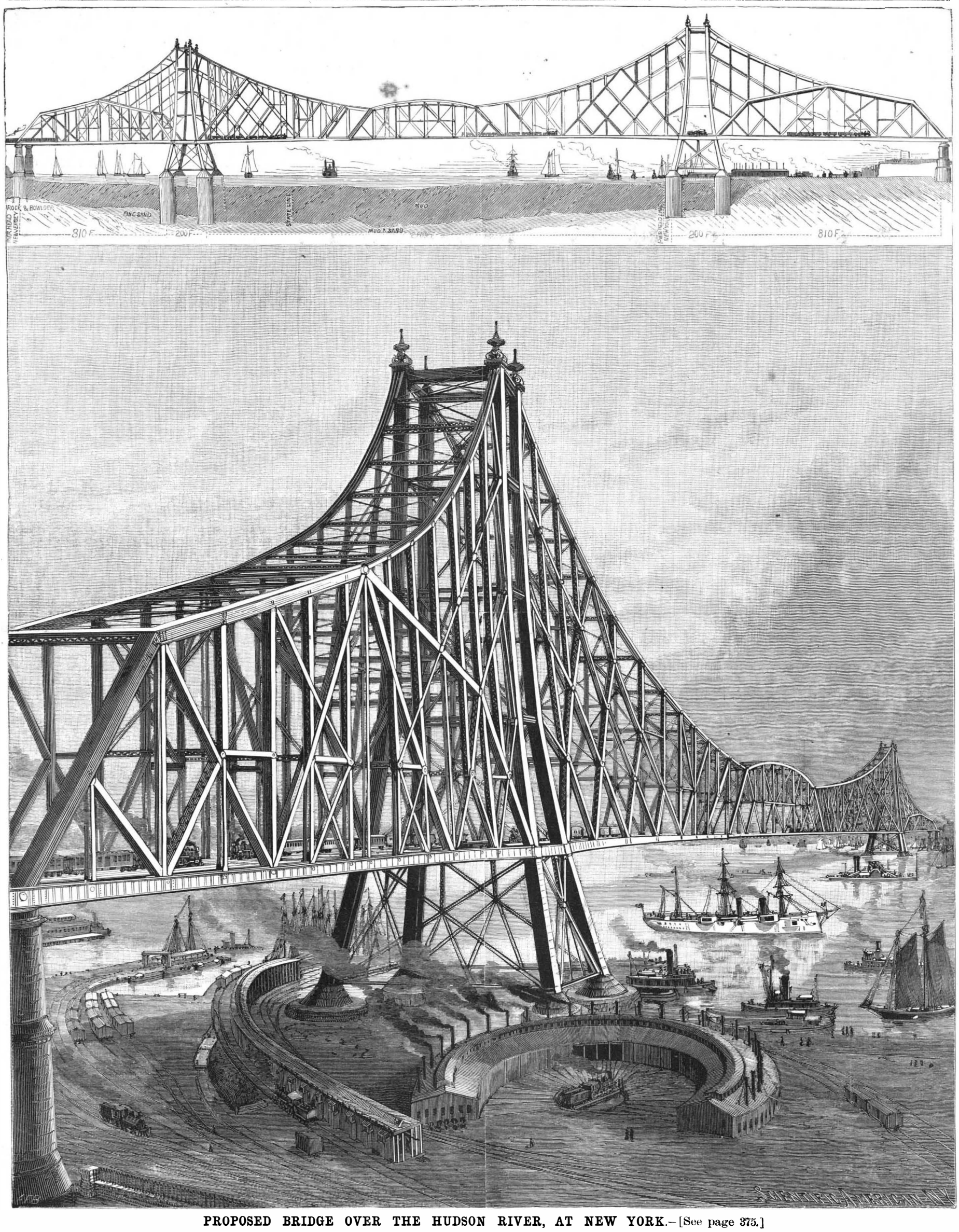

PROPOSED BRIDGE OVER THE HUDSON RIVER, AT NEW YORK.—[See page 375.]

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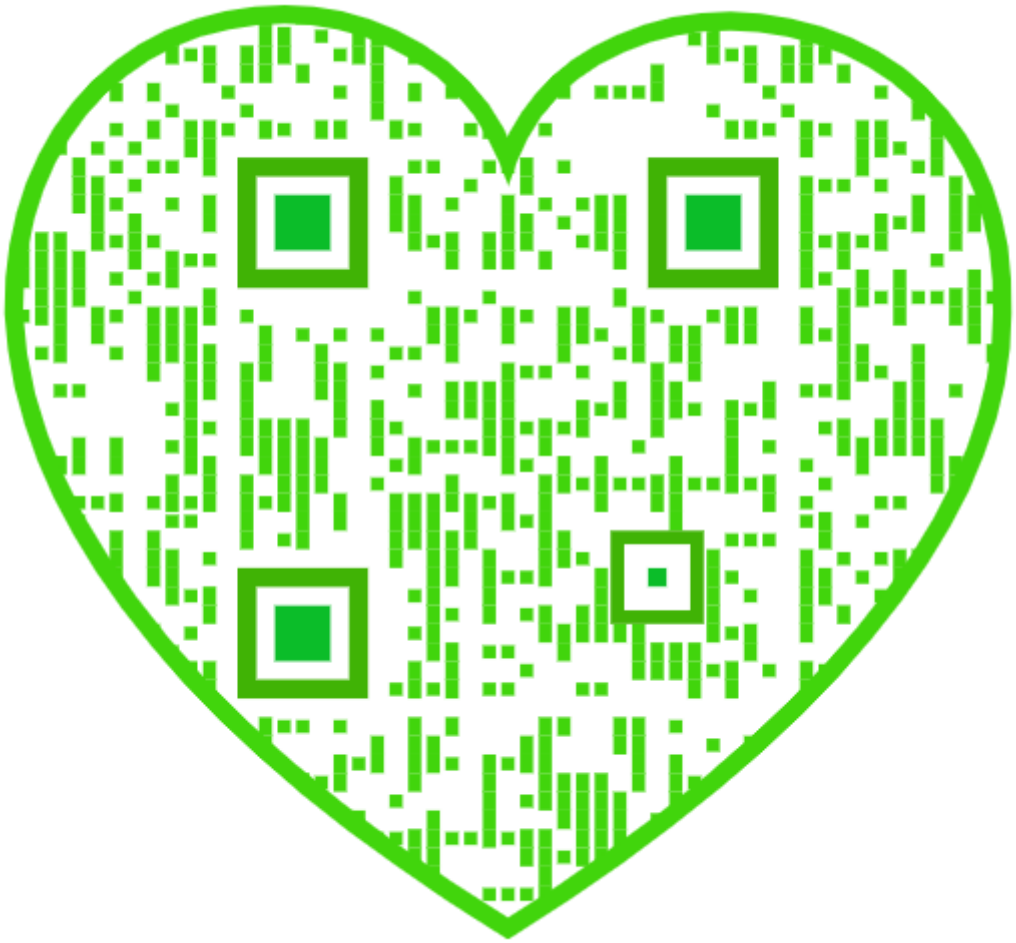

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OPENING OF THE FIELD MUSEUM.

The great Field Columbian Museum was opened June 2. The beautiful Art building of the Columbian Exposition, held at Chicago last year, has been utilized. On Oct. 26, 1893, Marshall Field, one of Chicago's merchant princes, subscribed $1,000,000, and the success of the Museum was assured. Donations poured in rapidly and the various States of the Union vied with foreign countries in supplying objects for the Museum. Many of the precious exhibits at the Fair were purchased by the managers of the Museum at very low rates. The valuable anthropological collection gathered by Prof. F. W. Putnam, of Harvard University, and the collection of exhibits of the world's railways are among the objects of interest. The large halls are devoted to special displays, while the smaller rooms are used to house the permanent collection. The director of the Museum is Mr. F. J. W. Skiff, late chief of the Mines and Mining building of the Columbian Exposition. The collections already gathered represent the progress of industrial art, relics of Columbus, zoology, lithology, mineralogy, and geology. The Museum will be open every day in the year, free on Saturdays, Sundays and all holidays, on other days by paying a small admission. The Field Museum will stand as a permanent memorial of the Columbian Exhibition, and no building could so appropriately represent the greatness of the Fair as the beautiful edifice designed by Mr. C. B. Atwood.

HOW TO PREVENT AND EVADE INSANITY.

The last number of the *Alienist and Neurologist* contains an interesting article by Dr. Wm. W. Ireland, of Edinburgh, on the above subject. He holds that persons accustomed to mental cultivation and discipline have great advantages in escaping from the taints of insanity. He thinks that mathematics is a very healthful exercise for a disturbed mind. He quotes Bacon, who says, "If a man's wits do wander, let him study mathematics, for in demonstrations, if his wits be called away ever so little, he must begin again." The learning of a new language, Dr. Ireland says, has been found by experience to engage the mind without fatiguing or harassing it. The study of animated nature, zoology and botany, with its illimitable fields and its cultivation of the inceptive and receptive faculties alike, and the opportunity it gives for outdoor exercise, is a valuable means of diversion for a mind unhinged or liable to become so. But we must not forget that all men are not studious; the great majority of men rather prefer pursuits which bring them in direct contact and dealing with the outer world. He who wishes to escape the morbid current of his thoughts and fears should select some one pursuit and involve himself in action concerning it. Of all such occupations known to us, gardening is the most wholesome and engrossing. Gardening gives exercise to the body and mind alike, and though mainly an out of door pursuit, it also gives some employment under cover.

Dr. Ireland's paper concludes with a number of excellent suggestions relating to the medical treatment of incipient insanity, the housing and care of patients.

PASSENGER RAILROAD TRAFFIC IN NEW YORK AND LONDON.

According to a recent article in the *Railroad Gazette*, the steam city railroads of London earn only $73,000 a mile, while those of New York City earn $300,000 a mile per annum. It appears the New York railroads carry a far larger number of passengers and run quicker and make more stops than the London roads. In New York it takes from 12 to 15 seconds for the people to get into and out of the cars, but in London it takes about 30 seconds, although the cars in London have side doors, which are supposed to afford greater facilities for the ingress and outgo for passengers. The *Gazette* says that the superior speed on the New York roads is largely a matter of smarter working. An underground road ought to be able to make greater speed, for it can use heavy engines and so get up to the maximum speed quicker; but, on the other hand, it is questionable if what they gain in this way is not lost in the greater caution needed in working heavier trains and working them in tunnels. These elements necessitate absolute blocking; but, on the elevated railroads of New York, worked in what is almost always a clear atmosphere and with but few obstructions to a long sight ahead, the trains can be run safely at a considerable speed without block signals. One train can run right up to the tail of another and thus take advantage of every second.

FREE ELECTRICITY.

According to a writer in the New York *World*, there are a number of places in the city of Brooklyn where electricity may be had free of charge, by simply connecting wires between water mains and gas pipes where they enter buildings. Along the lines of the trolley railways in Brooklyn there is a very extensive discharge of electricity into the ground, and these currents find their way to the water pipes and gas pipes. It is said that in some cases electricity enough to run fans and sewing machines, to the extent of over one H. P., can be had; it is stated that the gas pipe in almost any house near the trolley lines will give seven amperes and 300 volts, sufficient to run seven ordinary electric fans or furnish power for seven 16 candle lights. Such a current would do very much better than this. One of the experts said: "If you drive a couple of gas pipes to the return leg under the railroad track, you can get sufficient power to run heavy machinery." As this power seems to be running to waste in the ground, there appears to be no satisfactory reason why it should not be made use of free of charge by any one who has the good fortune to live along the line of the trolley railway. It is different from secretly tapping water pipes or gas mains. This electricity is running in the ground; it has been discharged or thrown away by the railroad company, which consequently can have no claim upon it.

THE LIMITATION OF VIVISECTION.

The benefits derived from vivisection are incontestable, but like some other good things, vivisection is often wrongfully used. The general public and even members of the medical profession are ignorant of the extent of vivisection and of the methods of its practice. In order to promote interest in this subject, a society, having headquarters in New York City, has been formed, entitled: "The Society for the Protection of Animals Under Vivisection." The object of the society is to spread information in regard to the extent of the practice of vivisection and to enforce the laws regarding it. The society is not antagonistic to vivisection when performed in the cause of science by professors of incorporated medical schools, but is opposed to the unauthorized practice in which animals are subjected to useless cruelty and to painful experiments which merely illustrate well known truths.

There is a too frequent use of vivisection in schools, which tends to deaden the youthful mind to the suffering of helpless creatures.

In most of the States vivisection is without legal restriction; but the State of New York provides that vivisection shall only be practiced under the authorization of an incorporated medical school or university (laws of 1867, chapter 375).

In the States which have no laws regarding vivisection, public opinion must be relied upon for a sentiment condemning its unnecessary practice. A request for reading matter on this subject, taken from the best authorities, will be sent on application to the secretary of the society, P. O. box 2828, New York City.

THE ENGINEER'S WORK IN MODERN BUILDINGS.

The profession of architect as relating to the designing of buildings has occupied a position intermediate between that of a profession and of an art. It has related to the production of the beautiful, and the architectural enthusiast has often placed his field of work on a par with music, and has regarded it as the crystallization of all that is best in the plastic and designing arts. A beautiful building appeals to the senses as a picture and as a statue, its effect depending partly on contour and partly on relief. Again, the artist proper may contribute to the decoration of a building. The sculptor may supply designs for caryatides, or may design special finials and other features that are truly statuesque. The artist in the realm of painting and drawing may control many elements of the design. The full architect, like Michael Angelo, should be both sculptor and painter.

But of recent years a new function has to be called in, in the construction of modern city buildings, which function is the work of the modern civil engineer. Occasionally in the past the engineering aspect was prominent in buildings. The Roman Pantheon and the Cathedral of St. Peter are examples of dome construction worthy of the highest praise as engineering achievements pure and simple. But with the advent of steel in place of stone a new type of engineer has arisen, one who by relying on a material of tensile and compressive strength many times greater than that of brick or stone, produces new effects. He builds bridges of spans only possible by virtue of the qualities of steel. The old-time stone bridge which would carry itself would carry any load that could be put upon it, and no thought of wind strains troubled its constructor. Its weight alone was enough to prevent the possibility of lateral displacement. In the modern steel bridge the load must be taken into account, the wind pressure must be provided for, and the effort is to make the trusses as light as possible. The relation of weight to strength is so much more favorable in steel than in stone or brick that the conservative element of weight of structure only obtains anything like its old sway in the largest of steel structures.

Steel has now invaded the architect's realm, and the last few years have seen a new type of city building evolved, one which would be impossible without steel, and in which the modern engineer asserts his presence. The twenty or more storied office building is now based on foundations made by caisson work, perhaps with compressed air. On the piers thus established the

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building is supported, its weight being distributed by steel trusses, which extend from pier to pier. A steel frame is carried up several hundred feet in the air, steel roofing trusses and beams are put in place, and the skeleton of the structure is complete. The process is comparable to the framing of a wooden house. The building is closed in with walls of brick and stone, but these represent only its sheathing. The building depends for integrity on its steel skeleton. In its frame even wind bracing is provided for.

It may be that a partition is required on a lower story, on the floor above which it is desirable that there should be an unbroken or undivided space. The engineer provides for this by including within the intermediate wall of the lower floor a truss, precisely such as would be used in bridge work. It is so throughout. The modern office building is only possible because of the engineer. In its roofing, flooring, and foundation, new engineering problems constantly arise, and the fully equipped architect is no longer the product of an apprenticeship at the drawing-board—he must be a capable engineer.

A DECISION RELATING TO ASSIGNMENTS.

A decision of considerable importance to all persons who hold property in letters patent by assignment has recently been made by the United States Court of Appeals. This is the case of the American Cable Railway Company *vs.* the Mayor of New York City. Heretofore it has been assumed, and in fact decided, by the State courts that the simple recording of an assignment in the Patent Office is *prima facie* evidence of the genuineness of the instrument; but the Court of Appeals now reverses this doctrine and holds than an assignment of a patent is not a public document, but is simply a private writing, and there is no statutory provision requiring an assignment to be recorded in the Patent Office. Section 4898 of the Revised Statutes permits this to be done for the protection of the assignee against a subsequent *bona fide* purchaser or mortgagee. The section does not make the recorded instrument evidence, and does not require the assignment to be executed in the presence of any public officer, or to be acknowledged or authenticated in any way before being recorded, and does not provide nor contemplate that it shall remain subsequently in the custody of the Patent Office. It devolves upon the Patent Office merely the clerical duty of recording any instrument which purports to be the assignment of a patent. "We are aware," says the court, "of no principle which gives to such a record the effect of primary evidence or of *prima facie* proof of the execution or the genuineness of the original document. To give it such effect would enable parties to manufacture evidence for themselves." The decree of the lower court was reversed and the complainant's bill was dismissed.

Heretofore, as above noted, it has been the practice simply to record an assignment in the Patent Office, the document being simply signed by the owner of the patent and attested by one witness.

In view of the foregoing decision, it will be well for those who are interested in patent property to take the precaution of having their assignments more fully authenticated and verified. Such documents should be executed before a notary public in the same manner that deeds and conveyances of real estate and other properties are certified.

Medicaments Derived from Coal Tar.

As a consequence of the progress made in the manufacture of coloring materials from coal tar, physiologists and physicians have been able to experiment with a host of new products, some of which have found a place as therapeutic or antiseptic agents. The substances submitted to such experiments are of very diverse nature, but there is observed in them, nevertheless, a limited number of characteristic groupings. They are phenols, acetylated amines and sulphonated, sulphureted, iodated and chlorated derivatives of the aldehydes. Methodical experiments have not been numerous enough and the data furnished by biological chemistry are not precise enough to allow us to establish any relation between the constitution of these bodies and their physiological properties, provided any exists. Their applications, in fact, exhibit many anomalies. We see products that are very different as to constitution act upon the organism in a similar manner, and substances that are analogous, from a chemical point of view, produce very different therapeutical effects. With the information that we possess upon this subject it is hazardous to draw absolute conclusions.

The number of organic bodies proposed as antiseptics or as medicinal products is very large, and one or more new medicaments are observed to make their appearance every day. We can mention but a limited number here, in selecting the most important of them.

We have arranged these substances as antithermics and analgesics, and hypnotics and antiseptics. There is nothing absolute about this classification. A large number of these products has at the same time several of these properties. For example, chloral, which we place among the hypnotics, is an analgesic, and is even employed as an antiseptic, and asaprol is at the same time an antiseptic and an analgesic.

1. *Antithermics and Analgesics.*—Of all the artificial antithermics, *antipyrine* or *analgesine* is the most widely used up to the present. It is derived from phenyl-hydrazine, which is itself obtained by dinitrating aniline and in reducing the dinitro-benzol thus obtained. This phenyl-hydrazine is afterward condensed with aceto-acetic acid, and then, finally, the product is submitted to a methylation. We have at last the dimethyl-phenyl-pyrazolon that constitutes antipyrine. It is very soluble in water, and this property permits of administering it under the most varied forms—a quality that is highly appreciated in pharmacy. It must be observed, however, that, as a general thing, solubility has no relation whatever with the quickness of action and assimilation of a medicament. Phenacetine, while being but slightly soluble in water, acts nevertheless as quickly as antipyrine.

The success of antipyrine has evoked a series of experiments with the object either of preparing substitute antipyrines and of analogous pyrazolons, or of associating it chemically with other substances. In the first order of ideas has been produced *tolypyrine*, which is a paramethylated antipyrine in the phenylic nucleus, and then chlorated, bromated, etc., antipyrines. In the second series antipyrine has been associated with salicylic acid, and this has given *salipyrine*. *Tolysal* is the salicylic combination corresponding to tolypyrine. Apropos of hypnotics, we may mention *hypnal*, which is a derivative of antipyrine and chloral.

Thalline and *kairine* are quinoleic products that have been proposed likewise as antiseptics.

Among the oldest analgesics and antithermics, we find *acetanilide* and *antifebrine*, which are prepared by treating aniline with anhydrous acetic acid. If, instead of operating with aniline, we start from hydroxylated aniline, that is to say, from a product which is both phenol and amine, and etherify it before acetylation, we shall have *phenacetine* or *phenedine*.

Thymatecine is the phenedine of thymol, and *exalgine* is derived from the acetylation of methyl-aniline.

Salicylate of soda has been for some time employed as an antirheumatic. Salicylic acid is a carboxylated phenol, that is to say, a body that is at once phenol and benzoic acid. It is prepared by passing a current of carbonic acid over phenate of soda at a high temperature. Several applications have been found for its derivatives, among which may be mentioned salipyrine, that we have spoken of above, and salol, which we shall find among the antiseptics.

Asaprol has the same action as salicylate of soda. It is obtained by treating beta-naphthol with sulphuric acid at a low temperature. It is the sulphuric ether of beta-naphthol. It is offered in the state of calcium salt very soluble in water. Under the name of *abrastol* it has been used as a microbicide.

2. *Hypnotics and Various Medicaments.*—One of the most frequently employed hypnotics is *chloral*, which is the hydrate of trichlorated acetaldehyde.

An endeavor has been made to associate it with various organic substances. In this way have been prepared: *Chloralose*, which is a combination of chloral and glucose; *hypnal*, which is due to the union of one molecule of antipyrine and one of chloral; and *somnal*, which is obtained from chloral and urethane.

Sulphonal is likewise a very efficacious hypnotic, but its constitution has no relation with that of chloral. Chemically, it is called the diethyl-sulphone of dimethyl-methane. It is formed by the combination of acetone with ethyl-mercaptan. *Trional* and *tetronal* form part of the same series.

For skin diseases there have been proposed *dermatol*, which is the subgallate of bismuth; *sulphaminol*, obtained by the action of sulphur upon meta-oxidi phenyl-amine; *resorcinol*, which is a combination of iodoform and resorcine; and *lysophane*, which is chemically called triiodo-meta-cresol.

Tumenol, *thioline* and *sulphonated thiophene* are designed for the same use.

Piperazine, a nitrated product of the closed chain series, is diethylene diamine. One of the processes of preparing it consists in causing ammonia to act upon bromide of ethylene.

Orexine serves to stimulate the appetite. It is a hydrochlorate of phenyl-dihydro-quinazoline.

3. *Antiseptics.*—Among the organic antiseptics, we find, especially, bodies with phenolic and aldehydic functions, and halogenated derivates.

Phenol, *beta-naphthol* and *gaiacol* are characterized by the phenolic grouping OH directly connected with the benzolic or naphthalic nucleus.

The use of a large number of phenolic derivates has been recommended. Thus, *salol* is salicylate of phenol, and *betol* is the salicylate of beta-naphthol. The union of benzoic acid with naphthol gives *benzo-naphthol*.

Abrastol, of which we have above spoken under the name of asaprol, is the salt of calcium of the sulphuric ether of beta-naphthol. It is a microbicide at present proposed for the preservation of wine.

Among the phenolic products of less importance, we may mention *alumnol*, *sozal*, *daphtherine*, *phenoline*, *cresine* and *microcidine*. *Iodoform* is triiodated methane, analogous to chloroform as regards constitution. This antiseptic has, as well known, an insupportable odor. An endeavor has, therefore, been made to substitute odorless and likewise iodated substances for it. Among the bodies proposed to this effect we may mention *diiodoacetylene* or *diiodoform*. In order to prepare this alkaline hypoiodites are made to act upon an aqueous solution of acetylene, or water upon a mixture of iodine and carbide of barium, or else by treating acetylene with iodine in the presence of an excess of potassa at a low temperature.

There likewise exists a *tetraiodo-acetylene*. The other iodated derivatives are: *Traumatol* (iodo-cresylol), *aristol* (iodo-thymal), *iodol* (tetraiodo-pyrol) and *sozoiodol* (diiodo-paraphenate of sodium).

Formol, which has recently been proposed as an antiseptic, is form-aldehyde. It has the great advantage of being volatile, and, consequently, of penetrating to the very interior of the objects to be disinfected.

Ichthyol, *anytine*, *thiol* and *thiolinic acid* are sulphonated and sulphureted derivates of organic and mineral oils employed in this state and that serve as solvents for products insoluble or but slightly soluble.

Among the substances mentioned, a small number only will doubtless receive the sanction of practice, but the road is laid out. On the one hand, syntheses are multiplying with the object of finding new series, and, on the other, the natural alkaloids are the object of numerous studies. With the means now at the disposal of chemistry, it is possible to study the active principles of digitalis, belladonna and a host of other natural products. We shall certainly succeed in giving such alkaloids a greater energy, perhaps new properties, and even replace them by substances of which the syntheses will be only the results of a study of the products, of their reduction and of their decomposition.—*Le Genie Civil.*

Trial of the New Warship Minneapolis.

When the Minneapolis returned from sea to Philadelphia June 7, she carried a broom on the foretopmast and on one of the funnels was painted the figures 21·75, which showed that the vessel is a record breaker. The speed of 21·75 knots per hour was made in an off-shore run under forced draught in comparatively shallow water, burning anthracite coal. At the above speed her shafts made 138 revolutions per minute, steam pressure 160 pounds. Streams of water were kept running over the bearings, but this was an unnecessary precaution, for none of the machinery became unduly heated. The Columbia, on her preliminary trial trip, made only 20·98 knots, so that the Minneapolis has proved herself to be the speedier vessel. Mr. Cramp said: "I am perfectly satisfied with the showing made to-day by the Minneapolis, and I expect her to do a knot and a quarter better under the same conditions as the Columbia."

The Minneapolis, a sister ship of the commerce destroyer Columbia, was launched August 12, 1893, at Philadelphia, in the yard of Wm. Cramp & Son's Ship and Engine Building Company. The new vessel is 412 feet long, beam 58 feet, mean draught 22 feet 6·5 inches, displacement 7,350 tons, indicated horse power 21,000. The hull is steel and has a double bottom, with considerable space between the two skins, this space being divided by numerous bulkheads into watertight compartments. The Minneapolis is, before all, a commerce destroyer, and is not intended to fight, so she is not armored. Her conning tower is of mild steel and her protective deck is a variety of turtleback, and is 4 inches thick on the sloping portion. The gun shields are two inches thick, or only sufficient to protect the gun crews from the fire of machine guns. Patent fuel will be stowed to a thickness of 5 feet around the machinery. The armament consists of one 8 inch standard breech-loading rifle, two 6 inch rapid-fire rifles, and eight 4 inch rapid-fire rifles. The secondary battery is composed of twelve 6 pounders, four 1 pounders, and four Gatling guns. The vessel is provided with five torpedo launching tubes. The 6 inch guns are loaded at one operation, as fixed ammunition is used, the powder and shot being combined in an immense cartridge, standing nearly 6 feet high.

The brag that the two new ships above mentioned are commerce destroyers, able to overtake any other ship afloat, remains yet to be verified. We hope the government will subject the vessels to actual trial. It is true the contractors have managed to squeeze a gratifying rate of speed out of them for a short time, everything being prepared and strained to the utmost. But how will it be on a sea voyage? Can these new vessels equal such merchant ships as the Campania, Lucania, Paris, New York, Majestic, Teutonic, Bismarck, Columbia, Normannia, which make from 20 up to 21½ knots per hour on almost every voyage? The experience thus far had with our most highly praised government ships is that they have never been able after being put into actual service to hold anything like their trial trip speeds. We venture to say that were the Columbia or the Minneapolis ordered to keep company with such boats as the Paris or the Campania on a voyage across the Atlantic, the navy ships would be left far astern.

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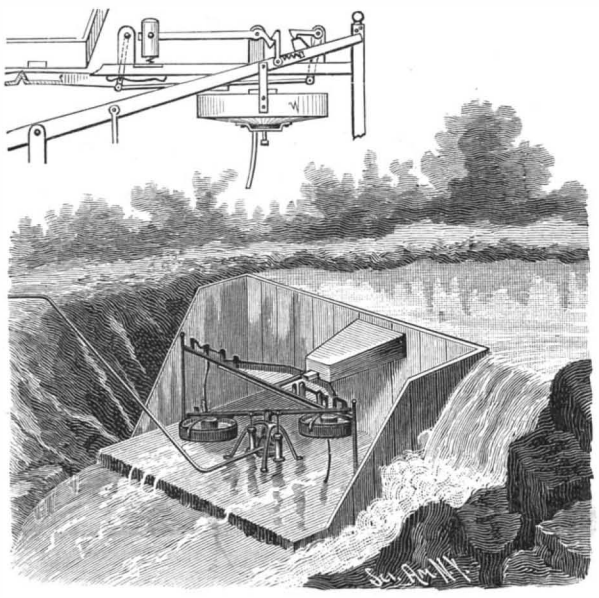
AN AUTOMATIC MOTOR.

In this motor a pivoted oscillating lever has at its ends buckets which alternately receive and discharge water as the ends of the lever rise and fall, the actual weight of the water thus operating the motor with very little friction and a minimum loss of power. The improvement has been patented by Mr. Charles W. Johnston, of No. 127 Pastorius Street, Germantown, Philadelphia, Pa. In the illustration the motor is represented operating a double-acting pump, which, with the motor, is arranged within a suitable open casing at the

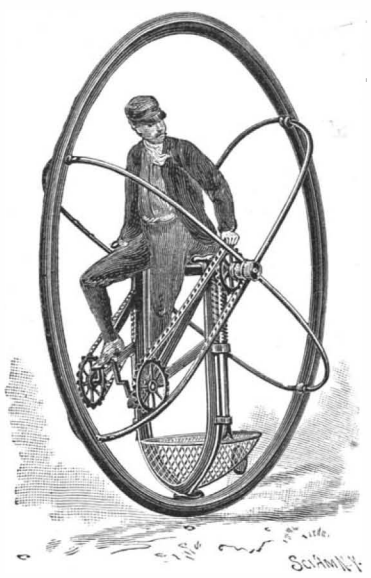


JOHNSTON'S MOTOR.

lower side of a dam in a small stream, the small figure being a detail view at one end of the lever with the bucket raised. In the middle of each bucket is a valve with downwardly extending stem which strikes the base of the frame when the bucket goes down, so that the valve is unseated and the water runs out, the valve being automatically seated when the bucket reaches its uppermost position, where it is connected with a water trough from a central chute. The beam is held in position, while being filled, by a hook which automatically engages a hook on a lever fulcrumed in bearings on the main frame, the other end of the lever being weighted and the weight resting on a spring, whereby the raised end of the beam is locked in place until the water entering the bucket overbalances the weighted lever. The horizontal water trough from which the buckets are supplied is supported by swinging hangers, the trough being connected by links with elbow levers pivoted in the frame of the motor above the highest point of oscillation, whereby the trough is alternately shifted to supply the bucket first on one side and then on the other. A curved guide rod steadies the buckets in their up and down movement.

AN IMPROVED UNICYCLE.

The wheel shown in the illustration, patented by Mr. Robert Hendrich, No. 1643 North Clark Street, Chicago, is designed to facilitate traveling at a high rate of speed, while being of comparatively durable and simple construction. The rim has a cushion tire, two outwardly curved webs from which form a casing or cage for the rider, the webs preferably forming spokes connected with central hubs in which is a shaft on which is loosely hung a frame carrying a seat for the rider. In the forward lower end of the frame are also journals in which turns the crank shaft, with crank arms engaged by the feet of the rider in the usual way, the sprocket chains connecting with wheels on the main shaft on opposite sides of the seat and within the hubs, whereby the wheel is rotated.



HENDRICH'S UNICYCLE.

The brake shoe is on the lower end of a vertically arranged fork, the upper end of each arm of which has a handle in easy reach of the rider, while springs on the fork arms normally hold the brake shoe out of contact with the rim. The wheel is held in upright position at rest by two rods sliding in vertical guides on the frame, the lower forked ends of the rods being normally held out of contact with the ground by springs, and the rods being pressed down into the ground by means of handles at each side of the saddle. At the lower extremity of the frame is a basket to hold packages, etc., and connected with the basket is a rod on which is held an adjustable weight to counterbalance the weight of the rider on the seat. That the rider may readily pass in or out of the cage, one of the spokes on each side is connected with the hub by means of a hinge, the outer end of the hinged spoke engaging a keeper on the side of the rim by means of a spring latch. The steering is readily effected by the rider bending to one side or the other.

The Late Captain Eads and the Manchester Canal.

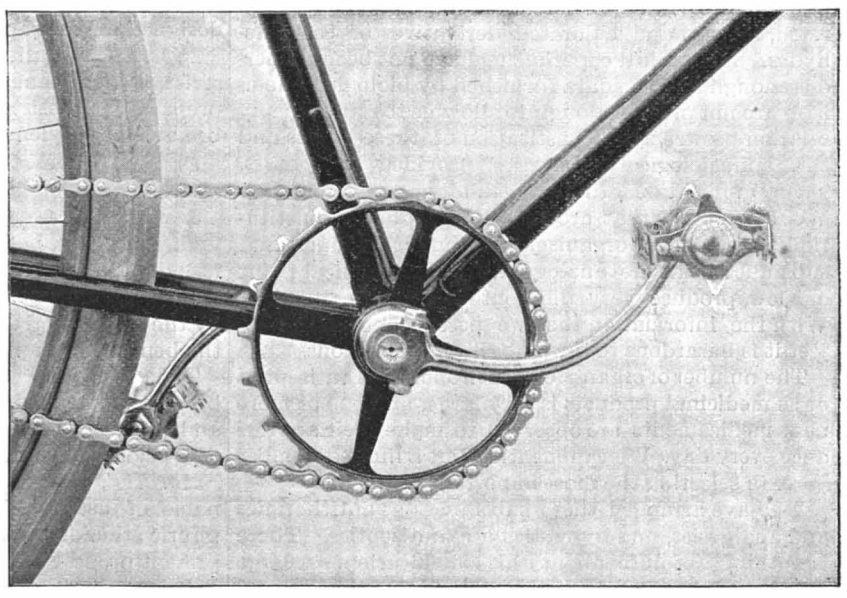
In the summer of 1884, exactly ten years ago, Captain Eads, one of the most eminent civil engineers of America, came over to give his opinion about the Manchester Canal, the inauguration of which is one of the memorable events of this year. Captain Eads it was who constructed the famous bridge over the Mississippi at St. Louis. It was he who built the jetties which enable deep water to be always counted on at the mouth of the Mississippi below New Orleans. The first public move in favor of the Manchester Canal was a meeting at Didsbury, near Manchester, in 1882. Captain Eads, before his examination by the Parliamentary committee, had thoroughly made himself acquainted with the whole region between Liverpool and Manchester. He had made maps of the bottom of the Mersey, and of the sea floor at the mouth of the river. He had no doubt as to the success of the enterprise which Mr. Adamson, the English engineer, had undertaken. The few survivors of that committee must remember the clear and decisive testimony of the American engineer. He knew nothing about the rivalries of Liverpool and Manchester, and gave no thought about the alleged saving of time or distance or cost in bringing passengers or freight or enlarging the water line for ships and trade. His one idea was that a vast new seaport would be made in a region of vast population, which would enable the produce of all the world to be brought to the people without break or change. He did not live to see the completion of the work, but his name is worthy of remembrance amid the triumphant celebrations.—*Leisure Hour.*

An Electrical Self-acting Rudder for Ships.

An interesting device by Mr. Bersier is described in *L'Ind. Elec.* The object is to operate the rudder of large vessels automatically by the compass directly without the use of the usual seaman. Attention is called to the fact that the errors in the ordinary method are scarcely less than from 1 to 2 degrees, corresponding to a lateral error of about 12 miles per day. With the present method greater accuracy is said to be possible; the standard compass is used and a current from a Ruhmkorff coil is passed from the pivot of the needle to the north pole extremity, whence sparks of 3 millimeters' length pass to one of two semicircular pieces of aluminum insulated from each other, the gap between them being set to the desired sailing direction. When the spark passes to one of these the current, by means of a relay, starts a motor in one direction, which in turn operates the rudder, while if the spark passes to the other piece, it moves the rudder in the other direction. The apparatus has been in use for two months on the steamer Neptune, and it operated very successfully. An additional device is mentioned, in which these sparks pass through a strip of paper, by means of which the record is automatically kept.

AN IMPROVED BICYCLE CRANK.

This crank, which was patented about a year ago, has attracted not a little attention among wheelmen, and seems to have given a good deal of satisfaction. As will be seen from the illustration, the crank is bent on about a quarter circle, and when much pressure is put upon the pedal the crank begins to straighten out, thus lengthening it and producing a longer leverage, with correspondingly greater power. It is claimed in this way to have greater advantages for hill climbing than any of the changeable speed gears, as there are no extra pieces to be attended to or get out of order, and the crank itself is made of a special quality of tempered spring steel, which cannot ordinarily be broken or permanently bent. In riding rough roads, also, it cushions the jolt, so that the vibration is nearly all absorbed without being transmitted to the body, rendering such travel much more comfortable than is possible with the ordinary straight crank. These elliptical cranks are a special feature to be found only on the Ide bicycles, manufactured by the F. F. Ide Manufacturing Co., Peoria, Ill.



THE ELLIPTICAL SPRING CRANK OF THE IDE BICYCLE.

AN IMPROVED FARM GATE.

According to the improvement shown in the illustration, which has been patented by Mr. Richard T. Mulcahy, of Rosenberg, Tex., the gate is supported centrally on a pivot post and adapted to be swung in either direction by levers and pull cords, the improvement being also applicable to a single gate. At the front and rear of the center of the gate opening are standards in alignment with the swing post, and above the top rail of the gate, at each side of the swing post, is pivoted a latch, the latches being guided in studs or standards on the gate and engaging keepers on opposite sides of the keeper posts. Each of these upper latches is also connected near its outer end by a vertical rod or link with a similar lower latch pivoted on the lower rail of the gate, and engaging a similar lower keeper on one of the keeper posts. Above the gate, on each side of the swing post, are fulcrumed bell crank or elbow levers, each of which is connected, at each end, by a link, with one end of a lever centrally fulcrumed on one of the standards in alignment with the swing post, each of these standards being also provided with upper and lower keepers adapted to engage the latches on the gate. On the central latch

MULCAHY'S FARM GATE

guide of each gate is also fulcrumed an elbow lever connected through a link by one of its members with one of the members of each of the elbow levers on the swing post, the other member of the elbow lever on the latch guide being connected with one of the latches on the gate. From each end of the levers pivoted on the standards at each side of the gate hang down pull cords, by means of which one approaching the gate on foot or in a carriage, from either direction, may, by pulling on one of the cords, actuate the levers on the central swing post, thereby first raising the latches and then swinging the gate open until the latches engage the keepers upon one of the standards. In opening the gate, the lever upon the standard is moved to a diagonal position by a slightly forward pull, and the gate is closed, after passing through, by a corresponding backward pull.

A New Electric Lighthouse.

The present Fire Island light on the south shore of Long Island is shortly to be replaced by a great electric light, said to be the largest ever made. It is claimed that it will have a brilliancy equal to twenty-five millions of candles. The lighthouse is 168 feet high and it is expected the light can be seen at a distance of 25 miles.

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THE FIREPROOF BUILDING CONSTRUCTION OF THE NEW JERSEY WIRE CLOTH COMPANY.

Fireproof building construction, as usually executed, involves the use of a very heavy mass of material. By this weight nothing is really gained and the building has to be made of additional strength to support the fireproof elements. Another feature of such construction is, if we may so express it, the inflexibility of the materials used, which do not lend themselves to any variety of design for special cases. Everything has to be fixed before the materials leave the factory. In the cut accompanying this article we present the fireproof method of construction introduced by the New Jersey Wire Cloth Co., of Trenton, N. J., methods which are now being employed to great advantage in the new Broad Street station of the Pennsylvania Railroad in Philadelphia, Pa. Our illustrations represent principally the work actually executed in that building and show how admirably the system lends itself to ornate and massive design.

Figs. 1, 2, and 3 show floor and ceiling construction. A curved piece of wire cloth, stiffened by transverse and longitudinal ribs of light iron rod, spans the interval between two wall beams. On the wire cloth thus established cement concrete is deposited and hardens, giving a floor of very great strength and far lighter than the usual construction. The ceiling may be treated in several ways. In Fig. 1 the flat ceiling is shown, on which a flat sheet of wire cloth is supported by tension rods extending from Ib to Ib, which rods are stiffened by suspending wires running from the arch above them. The wire cloth is fastened to the supporting rods by short pieces of wire, and its surface is plastered, giving a flush ceiling. Fig. 2 shows an arch plastering where the flat sheet of wire gauze is dispensed with, and a ceiling consisting of a series of arches results.

In Fig. 3 a modification of the design is shown, in which an angle iron running longitudinally and suspended rigidly from the arch above is used to support and stiffen the wire cloth. The transverse rods are attached by clips to the lower flange of the I beams, and in the small cut of "materials" this clip arrangement is shown. If tension rods are used instead of the clip rods, special clips are employed for their ends. Such a tension rod with its clips is also shown among the cuts of material.

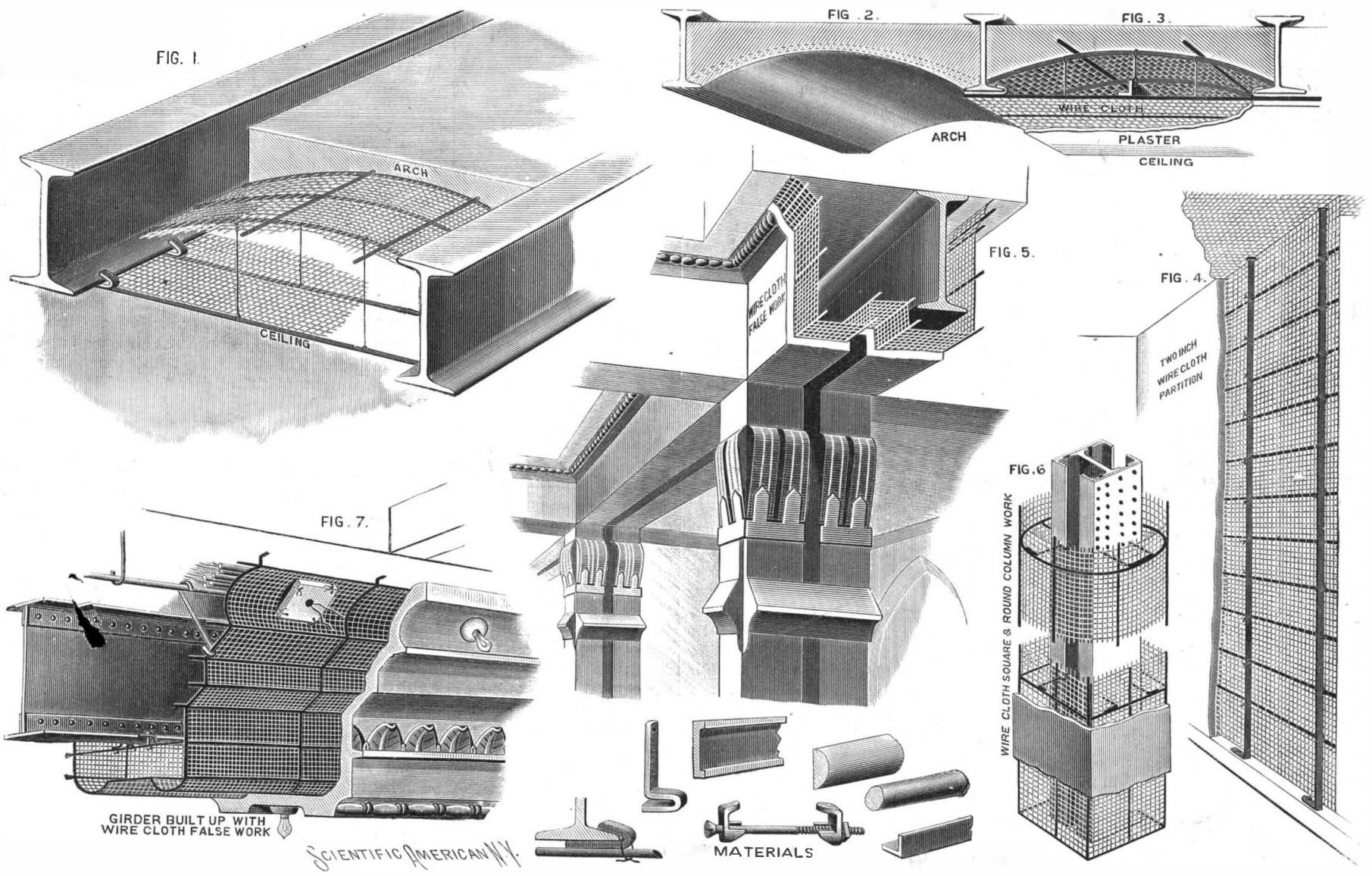
Fig. 4 shows a fireproof partition consisting of angle iron risers, wire cloth with rods woven into it at intervals of 7½ inches, and plaster. Such a partition, 2 inches thick, is amply thick for all purposes and involves a great saving of space.

Fig. 5 shows a more elaborate piece of construction. Here the actual frame of the building includes a single horizontal I beam. By longitudinal rods, by cross section rods bent to the proper profile and by wire gauze laced thereto, a framework is produced for plastering by which the heavy double ceiling beam is produced, whose massive effect is so well rendered in the cut.

In Fig. 6 is shown round and square column work, the wire gauze with cross section rods and longitudinal rods being studded off from the iron column by special clips. The large columns of Fig. 5 are built up from the iron core by the methods illustrated in this cut.

Fig. 7 shows a construction of a heavy cornice, where is shown in detail the use of the cross section rod or profile piece. It is made of light iron, bent by hand and in the building on a shaping plate to the desired outline. It takes but a few seconds to make one of these profile pieces. They are held in place by clamps attached to the beams and by suspension pieces. Longitudinal rods are fastened to their angles; on this framework wire gauze is placed, and all is then ready for the plaster, which in part of the cut is shown applied.

Another interesting feature of the work appears in this cut, which is its adaptability to electric light work. At the desired intervals in the cove of the cornice holes are cut, through which wires for lamps are laid. Back of the wire cloth is ample room for the cables. This square board shown in the cut serves for the attachment of the lamp socket. It is entirely concealed by the application of the plaster. In the cut of the materials are shown the sections generally employed, which, it will be observed, are of ordinary merchant iron. The Pennsylvania station presented an admirable field for the system, and its capabilities have been taken full advantage of by the architect.



THE FIREPROOF BUILDING CONSTRUCTION OF THE NEW JERSEY WIRE CLOTH COMPANY.

The Gastrograph.

At a meeting of the Medical Society of the County of New York, held in the Academy of Medicine, on Monday evening, May 28, Dr. Max Einhorn read a paper entitled "Demonstration of the Gastrograph."

The gastrograph, in appearance, bore a resemblance to a stock indicator, but was constructed to record the motions in the stomach of a patient under treatment. The movements of the food while it is undergoing chemical action are carefully and minutely recorded by means of electricity.

Two of Dr. Einhorn's patients were brought before the members of the society. A dry electric battery was connected with the apparatus, and a brass ball at the end of an electric wire was put into the mouth of one of the subjects and swallowed. A connection was then made with the electric wire from the patient's stomach and the apparatus.

The patient first operated upon was a healthy medical student, who swallowed the electric coil and a bulb like one used to such experiments. When the electric current was turned on the gastrograph gave a "whirr-tick-tick" like a stock indicator and a long paper tape was unrolled on which the motions were recorded by long or short lines.

The second man operated upon was a patient who was under treatment for catarrh of the stomach. This patient swallowed the brass ball and the coil of electric wire with difficulty, and took frequent draughts of water. The gastrograph was set in motion and the slow action of this patient's digestive organs was apparent.

The medical men were invited from their seats to inspect the indicator at short range. The novelty of the apparatus and the experiment caused the members of the society to crowd around the operating physician and his willing subject. The taking of the brass ball from the patient's stomach was no easy task, but the doctor pulled with care, and the bulb was finally extracted from the man's throat, much to his apparent relief.

A Fraudulent Mat.

A new cheat in the form of a floor mat has been introduced recently, and owing to the attractive appearance of the mat it is meeting with ready sale. But the whole thing is a fraud. The mats are supposed to be made of textile materials, but nothing else than cheap wood stock paper yarns are used in their construction. The mats are selling for $1.50 apiece for the common door size, but in reality they are not worth 25 cents.

The mats are intended for use in front of door in sitting rooms, libraries, etc. They are made as follows:

The cheapest of wood pulp is procured from the pulp mill and taken to the establishment in which the mats are made. The pulp is run off into strands through tubes and rendered about the size of common weaving yarns. These strands are polished and coated with an application consisting of tallow, glue, borax, and one or two other ingredients, so as to make the threads elastic. Then the yarns are woven into the form of a mat.

Around the edges of the mat is sewn a fairly good border of substantial textile material, evidently so as to help deceive. The border costs more than the mat. The paper stock is very cheap. Such mats can be made for a few cents apiece. They are selling for $1.50. The mats look well, but they will not last. A little water turns the material back to pulp. Dampness affects the texture. When trod upon, the strands, if dry and stiff, break and become worthless. The mats are still in the experimental stage, but may get into the general market soon.—*Commercial Bulletin.*

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Culture of Plants Under Colored Glass.

The influence exerted by colored glass upon the development of plants is a subject that has attracted attention for a long time. All luminous radiations are far from presenting the same efficiency in forcing the growth of plants. The most recent work done in this line of research is due to Mr. Villon, who, in the first place, instituted a series of laboratory experiments. He placed some potted plants in a large, well ventilated case, presenting all the conditions beneficial to their proper development. The panes of glass of this case could be easily replaced by others of different colors. His experiments were made upon the following kinds of glass: (1) White glass; (2) uranium glass absorbing light; (3) blue glass colored with cobalt, allowing only the red and ultra-violet to pass; (4) blue glass colored with copper, allowing the ultra-violet to pass and absorbing the extreme red rays; (5) red glass colored with protoxide of copper, absorbing all the colors of the spectrum between red and blue; (6) glass made orange color by a coating of bichromate of potash and allowing only yellow and red to pass; (7) violet glass colored with manganese, absorbing the yellow and blue; (8) green glass colored with protoxide of iron, absorbing the red rays; and (9) glass covered with a thin layer of silver, allowing only the blue rays to pass. The results obtained are found in the following table, where the growth of the plants under white glass is represented by 100:

Culture under white glass	100
" " bichromated orange glass	150
" " manganese violet glass	150
" " cobalt blue glass	140
" " copper blue glass	120
" " silvered glass	60
" " uranium glass	40
" " gilded glass	40
" " red (protoxide of copper) glass	15
" " green (protoxide of iron) glass	10

It must be concluded from these figures that the light that favors vegetation best is the orange light of the chromic glass and the violet light of the manganic; and, as the radiations that these glasses allow to pass are the red ones, it is, in definitive, red that is most favorable to the development of plants.

Mr. Villon has made some new experiments, whence it results that the best light is that which traverses manganese violet glass, that is to say, that which contains the red, the violet and the calorific rays. These latter experiments were made upon the grapevine, ornamental flowering plants, the useful ferments (yeast of beer, ferment of wine, butyric ferments, etc.), and, finally, upon silkworms, which are more vigorous when they are raised in a room lighted by violet glass. —*Magasin Pittoresque.*

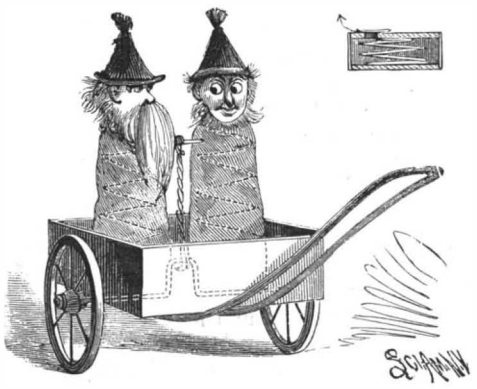
Evolution of the Match.

The lucifer match has attained its present high state of perfection by a long series of inventions of various degrees of merit, the most important of which resulted from the progress of chemical science. Starting from the ingenious tinder box and lyrstan of our Saxon ancestors, the first attempt, so far as I know, to improve on the old sulphur match was made in 1805 by Chancel, a French chemist, who tipped cedar splints with a paste of chlorate of potash and sugar. On dipping one of these matches into a little bottle containing asbestos wetted with sulphuric acid and withdrawing it, it burst into flame. The contrivance was introduced into England some time after the battle of Waterloo, and was sold at a high price under the name of Prometheans. I remember being struck with amazement when I saw a match thus ignited. Some time after this a man named Heurtner opened a shop on the Strand, opposite the church of St. Clement Dane. It was named the Lighthouse, and he added this inscription to the mural literature of London: "To save your knuckles, time and trouble, use Heurtner's euperion."

An ornamental open moirée metallique box containing fifty matches and the sulphuric acid asbestos bottle was sold for one shilling. It had a large sale, and was known in the kitchen as the Hugh Perry. Heurtner also brought out vesuvians, consisting of a cartridge containing chlorate of potash and sugar, and a glass bead full of sulphuric acid. On pressing the end with a pair of nippers, the bead was crushed and the paste burst into flame. This contrivance was afterward more fully and usefully employed for firing the gunpowder in the railway fog signals. We now come to Walker. He was a druggist at Stockton-on-Tees, and in 1827 produced what he called congreves, never making use of the word lucifer, which was not yet applied to matches. His splints were first dipped in sulphur and then tipped with the chlorate of potash paste, in which gum was substituted for sugar, and there was added a small quantity of sulphide of antimony. The match was ignited by being drawn through a fold of sand paper, with pressure; but it often happened that the tipped part was torn off without igniting, or, if ignited, it sometimes scattered balls of fire about, burning the carpet and even igniting a lady's dress. These matches were held to be so dangerous that they were prohibited by law in France and Germany. The first grand improvement in the manufacture took place in 1833 by the introduction of phosphorus into the paste, and this seems to have suggested the word lucifer, which the match has ever since retained. When phosphorus was first introduced to the match maker its price was four guineas a pound, but the demand became so great it had to be manufactured by the ton, and the price fell to half-a-crown a pound.—*Notes and Queries, London.*

A TOY CART.

This simple toy for the diversion of children has been patented by Mr. Paxton Pollard, a deaf mute

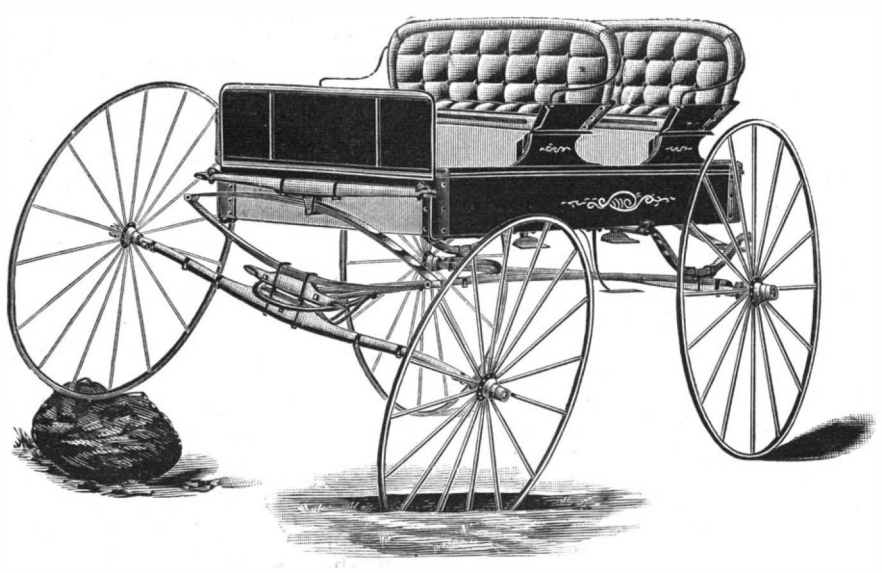


POLLARD'S TOY CART.

printer, of No. 89 Main Street, Norfolk, Va. When the cart is drawn along, either forward or backward, the figures are caused to bend or bow simultaneously, and at the same time, by the compression and escape of air, through drum-like pedestals beneath the figures in the cart body, a whistling or squawking noise is made. The figures may be of any desired grotesque shape, formed of paper or other suitable material, and in each is a spiral spring, normally holding the images upright. The pedestals, of which a sectional view is shown in the small figure, have each an upper and lower head and a covering of thin skin or something similar, and in each is a coil spring, while in each upper head is a small opening covered by a thin metallic tongue, arranged to vibrate rapidly on the passage of air through the opening. The upper portions of the two figures are connected by a transverse rod, and this rod is centrally connected by cord or rod with a crank in the central portion of the axle, whereby the figures are made to bend or bow as the cart is drawn along.

AN OSCILLATING DEVICE FOR VEHICLES.

Mr. E. M. Crane, of the Thompson Carriage Company, Oshkosh, Wis., has patented a device adapted to permit the tilting of the axle and spring of a vehicle, when a wheel passes over an obstruction or into a depression, without disturbing the equilibrium of the carriage body, as shown in the illustration. The ordinary crossbar is attached to the front end of the body by loops, permitting the low hanging of the body, and the bar is rigidly attached centrally to a bifurcated pendent connecting and guiding device embracing the leaves of the upper half of the spring. The bottom plate of the device, on which the upper half of the spring bears, has at its center a downwardly depending lug, in which is an eye for the passage of a bolt, the plate forming a pivotal support or means of oscillation. The whole construction is designed to bring the pivotal bearing as low as practicable, permitting maximum oscillation of the gear part.



CRANE'S OSCILLATING DEVICE FOR VEHICLES.

Ants as Bridge Builders.

The following story, told by an eyewitness to the *Rocky Mountain News*, is entitled to a place among the instances of intelligence among the lower animals. A cook was much annoyed to find his pastry shelves attacked by ants. By careful watching it was discovered that they came out twice a day in search of food, at about seven in the morning and four in the afternoon. How were the pies to be protected against the invaders? He did not have long to wait, for at 6:50 o'clock he noticed that off in the left hand corner of the pantry was a line of ants slowly making their way in the direction of the pies. They seemed like a vast army coming forth to attack an enemy. In front was a leader, who was larger than any of the others, and who always kept a little ahead of his troops. They were of the sort known as the medium-sized red ant, which is regarded as the most intelligent of its kind, whose scientific name is *Formica rubra.*

About forty ants out of five hundred stepped out and joined the leader. The general and his aids held a council, and then proceeded to examine the circle of molasses. Certain portions of it seemed to be assigned to the different ants, and each selected unerringly the points in the section under his charge where the stream of molasses was narrowest. Then the leader made his tour of inspection. The order to march was given, and the ants all made their way to a hole in the wall, at which the plastering was loose. Here they broke ranks, and set about carrying pieces of plaster to the place in the molasses which had been agreed upon as the narrowest. To and fro they went from the nail hole to the molasses, until, at 11:30 o'clock, they had thrown a bridge across. Then they formed themselves in line again, and marched over, and by 11:45 every ant of the foraging expedition was contentedly eating pie.

Compressed Air Devices.

Mr. F. M. Twombly, master mechanic of the Old Colony at Roxbury, Mass., related some of his experiences with compressed air devices in shopwork at the May meeting of the New England Railroad Club, as reported in the *National Car Builder.* He said: I commenced the use of compressed air some two and a half years ago. The first thing I did was to make a hoist out of brass tubing, using for a piston rod cold-rolled steel shafting. I constructed the hoist for experimenting. At that time we were taking up our rails on the Providence division, and they were to be shipped to Cape Cod for a second track. We had to drill two holes in each end of the rail, and two men were employed with a suspended drill for this purpose, one man receiving $1.50 a day and the other one $1.75 a day, and at night they were pretty tired with their work. The rails were raised with a chain and fall, which had a one ton lift, and cost $35. The hoist which I constructed and put upon this work cost $28. I kept an account of the whole matter, and found that the hoist paid for itself in 15 days. I put up hoists all over the shop for lifting all kinds of machinery and 42 inch passenger wheels. I rigged a radial run hoist for various uses, and I propose to put up one in place of the derrick we have been using. I have used the air for elevating purposes, for lifting a cab through the floor, laying the hoist horizontally. The power can be multiplied or divided, as on any block and fall. The one we use for lifting through the floor has a cylinder 15 feet long. In the first hoist I spoke of, the diameter of the tube was six inches and its capacity 1,500 pounds. I put a cylinder under the floor of the room to lift up wheels. I force oil out of the barrels into the tank by means of this power, using a sliding pipe, letting a little compressed air on top of the oil in the barrel, and it is forced into the tank. A barrel of water can be emptied very quickly in that way. I am constructing a machine to take sand into a tank the same as water. In the tank shop, where we build tanks for the whole system, we construct a great many, and they are built upside down. We have formerly turned them over with a block and fall, but now we have got some hoists to handle those tanks by means of air. I use this power on a copying press; also to force oil onto a bolt when cutting it. I take an auxiliary reservoir and fill it with oil, letting a little compressed air onto the oil, and it can be applied to the work as you like, and when you want to run it into the tank again you remove the pressure and let it run back by gravitation.

There are thousands of things it can be used for, and there is no difficulty in running it up and down the yard; it is only the cost of the pipe and the slight labor of putting it down. I have an overhead railroad in the yard, with hoists to load and unload cars, and for taking ashes out of tubs into cars, and I use this power in many other ways. I am indebted to Mr. Medway for the plans for a pit for a pneumatic turntable.

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THE HUDSON RIVER BRIDGE OF THE NEW YORK AND NEW JERSEY BRIDGE COMPANY.

In the engineering history of the world certain bridges seem to occupy the position of milestones of progress, each indicating for its own time the limit of engineering skill and daring, only to be replaced and superseded by the new. Especially is this the case with iron and steel bridges. Fairbairn's and Stephenson's tubular structures excited in their time the greatest admiration, while to-day the system is quite discarded. The Menai Strait bridge, called the Britannia bridge, one of the greatest triumphs of Robert Stephenson, a wrought iron rectangular tube, varying from 30 to 22 feet 9 inches in height and 13 feet 8 inches in width, with two maximum clear spans of 460 feet each, was completed forty-four years ago, and was long regarded as the greatest bridge in the world. The opposite of the tubular type is the suspension bridge, of which the great Roebling left two grand examples as monuments for himself in this country—the Niagara railroad suspension bridge—821 feet from center to center of piers, and the East River suspension bridge, 1,595 feet 6 inches span, connecting this city and Brooklyn. Years of use of these structures have shown what may be expected of suspension bridges.

Next, what is really a very old type, the cantilever, began to come more to the front. The idea of balancing a double truss on its center, and building out to right and left over space, dispensing with false work, was an attractive one, and to-day this is the prominent type of large bridge. The world's greatest bridge, the only one surpassing in span the beautiful East River structure, is a cantilever. This is the Forth bridge, in Scotland, which, some 200 feet more in span than the East River bridge, stands as an example at once of daring of execution and of ugliness of design. For, by concentrating the structure in the cantilevers, and employing a very small central truss, utter disproportion has been brought about.

We illustrate in this issue the proposed bridge of the New York and New Jersey Bridge Company, designed to cross the Hudson River at about the line of Sixty-ninth Street, in this city. In it is found an example of how a cantilever bridge can be redeemed from ugliness, for, though it is in one sense the extreme development of the type, it resembles in its lines a suspension bridge. When this is erected the Forth bridge will have to take second place, the new bridge having a central span over 400 feet longer than that of the Scotch structure. It is the design of the Union Bridge Company, of this city.

Each of the main piers, which are of steel and are two in number, have four main members, rising in parabolic curves from its bases, each of which bases defines a square, measuring from center to center of corner piers 200 feet on each side, up to another square at the top, measuring 80 feet on each side. The bases of these corner members rest on cones, which are carried by four steel tubes, each 80 feet in diameter, and sunk to a sufficient depth in the river bottom. The greatest depth will be about 210 feet from high water level. These tubes, after sinking, are to be filled with concrete, and most of the weight of the bridge is to be carried by eight of them, four for a pier. Each of the main members or risers of the pier, which look so light and graceful in the illustration, is to be 15 feet square, of box girder type, so that each will be about as big in section as the entire tube of the Britannia bridge. Were one of them placed on the ground, a train of cars could pass safely through it. The piers rise 536 feet above high water. The top of the supporting cones are 30 feet above it.

From the piers the main span starts at an elevation of 150 feet above high water, and in three equal bays covers a space of 2,300 feet from center to center of piers, giving a clear span of 2,020 feet. The railroad trains shown on the bridge in the illustration give a good idea of the dimensions of its members. It is enough to state that the bottom chords are to be 15 feet high, and that from the top of the towers the tension bars start off, 48 in number for each side, each bar being 12 inches deep and 3⅛ inches thick. If these were consolidated, they would give a beam over 12 inches by 12 feet in cross section of solid steel.

The piers, as has been stated, rise with a parabolic curve, concave outward. The floor has a similar curve lying in the horizontal plane, as it narrows from a width of 140 feet at the pier to a width of 80 feet before the central truss is reached. The effect of this is peculiar. It brings the upper tension members into absolute parallelism throughout. These in contour resemble the cables of a suspension bridge, and each occupies a vertical plane. There are other tension members, roughly speaking, of the reverse contour, running from three intermediate points on the pier risers to three points on the bottom chord of the bridge. The disposition is such that each of these members is parallel with the corresponding ones on the other side, starting from points on the pier where it is of widths equal to the widths of the floor at the points where each tension member terminates.

The central truss carried by the cantilevers is 720 feet long and 160 feet in depth.

The eastern main pier is shown placed even with the pier head line of New York City; the western main pier is well out in the river. The eastern abutment pier is located nearly 1,050 feet back from the New York pier head line; the western one is to be even with the pier head line on the New Jersey shore.

The trusses spanning the shore intervals, each of 910 feet in length, center to center of pier bases, are not heavy enough to balance the river span, the central truss going to establish a great excess of weight on the river side. Accordingly the four abutment piers are hollow; the end of the shore trusses are to rest on rollers or some equivalent on the tops of these piers and are to be held down by pig iron weights suspended from their ends and hanging within these piers. An aggregate weight of thirty million pounds will be needed for these weights alone.

The floor of the bridge, which is practically level, will vary in width from 140 feet at the piers to 80 feet at the center. It will accommodate six tracks. It will have no roadway for carriages and no public foot-path.

The total length of the bridge, exclusive of approaches, is 4,120 feet, center to center of end piers.

The small proportions of a railroad train compared to the size of the bridge have already been adverted to. This fact is well brought out in the calculations for the strength of the members of the bridge. Calculated to be self-sustaining, its factor of safety alone is enough to take care of any cars running over it. Its construction by the regulation methods will be an impressive spectacle, after the two center span cantilevers will have reached their limit and the parts of the center truss begin to close the gap. At one time there will be overhangs of 1,000 feet each from both sides.

The approaches on the New York side will be commensurate with the size of the structure. Facing on Seventh Avenue at its intersection with Broadway, with a total front of 462 feet, will be two hotels with the station entrance between them. From Seventh Avenue the hotel and station buildings are to be run to the westward, diminishing in width until a total length of 1,700 feet is attained. Running parallel with Forty-third Street to Seventh Avenue, then curving up toward Forty-sixth Street, and running parallel with it until near Eleventh Avenue, the tracks are to go north parallel with the last named avenue until they sweep around upon the bridge.

It is a somewhat striking fact that of the many travelers who go to the westward from New York City daily, all have sooner or later to cross the Hudson River. At present it is crossed by inconvenient ferries at this city and by a bridge at Albany nearly 150 miles to the north. The Poughkeepsie bridge does but little for travelers. The new bridge with its six tracks and with the great terminal station will enable the traveler to start directly from New York City by rail for all points to the south and west, to Philadelphia, New Orleans, Chicago or Yokohama, without going north 150 miles to cross the intervening waters of the Hudson River.

On June 5 the United States Senate passed an amended bill, authorizing the construction of the bridge, and placing the matter in the hands of the Secretary of War, as regards approval of the recommendations of the Board of Engineers. On June 6 the House of Representatives passed it, and it has been signed by the President. A period of ten years is allowed for the completion of the structure.

Novelties in Photography.

In the course of an article recently contributed to *Le Monde Illustré*, the *Photographic News* says the writer, M. Henri Coupin, makes the following remarks concerning the work of M. Marey and others:

We know what a change M. Marey, the learned professor in the College of France, has brought into physiology, physics, and art by chronography, which consists in photographing a moving object at almost imperceptible intervals. After having studied in all its details the progress of a man and horse, as well as the flight of birds, M. Marey has applied himself to animals more difficult to handle, such as serpents, eels, insects, spiders, scorpions, etc. For each of these it was necessary to take instantaneous photographs, and even more important to have recourse to peculiar conditions of light. This consists in lighting the creature above and below in such a manner that in the separation from its silhouette the insect throws its shadow forward on the track that it is crossing. This shadow gives us some information about the position of the claws; when they are placed on the ground, the representation of the claws themselves and the shadows touch each other at the extremities. We can also see that the insect always rests on three claws, while the three others are moving, the claws resting on the ground forming a triangular base formed by the first and third claws on one side and the middle claw on the opposite side

Notwithstanding the difference of the medium in which they live, the eel and the adder progress in the same fashion; there is no difference, only in the amplitude of the undulations.

With the toad a curious fact is observed: as long as it is in the tadpole state, that is, while it has a tail, the feet move more by successive expansions. Later, when the tail has fallen off, the hind feet move exactly as a man's limbs do when he is swimming.

M. Marey has not confined himself to the study of animals; he has set himself to a more arduous task—photographing the movement of liquids. For this he uses an elliptical tube whose walls for a part of their length are rectilinear and formed of glass. Water is put into this spout and a black cloth is placed in the center of the receiver; the camera has been previously united to the receiver by a hollow pyramid of dark curtains. By lighting the receiver from below, the edge of the water alone is luminous, and can consequently be photographed. By agitating the water, the movements of the surface of the water can be given. "When," says M. Marey, "we wish to photograph the movements which are going on in the interior part of the liquid, we make them visible by means of little shining bodies in suspension in the water on which the solar light shines brightly. For this purpose we have wax melted in suitable proportions; its density is less than water, and we add resin, whose density is greater; then with this plastic material a great number of little balls are made and silvered by a process used in pharmacy. These brilliant pearls must be a little denser than fresh water, so that if we put them in it, they go slowly to the bottom. It is sufficient then to add gradually in the tube a certain quantity of salt water, so that the shining pearls are suspended in the mixture; the equilibrium or disposition is not important. When this is accomplished, miniature tempests are provoked in the receiver, and photographs are taken rapidly. This has not been applied to any practical purpose, but we must never despair in matters of science. While studying the angles of the crystals of tartaric acid, Pasteur was led to a cure of hydrophobia and many other diseases; perhaps while studying the liquid waves some one may learn to conquer tempests, or at least to control seasickness.

The inmost recesses of the eye are of much interest to a physician. M. Guilloz has just found a simple way of photographing it with sufficient clearness. The difficulty consists chiefly in eliminating the reflections produced by the cornea and the crystalline humor of the eye; this is got rid of by putting a lens before the eye. The head of the patient is kept immovable by means of a head rest. In the dark room an inclined mirror is arranged which reflects back the image on a piece of ground glass placed on the upper part. The sensitive plate is placed behind the mirror so as to shield it from all light. When the reflection shows clearly on the ground glass, the mirror is raised. This movement uncovers the sensitive plate; at the same moment an explosive cylinder of magnesium is fired, which produces a dazzling effect. The inmost part of the eye is photographed with all its details. The eye being the mirror of the soul, these photographs may be of use in showing the character and disposition of individuals; possibly with fortune tellers they will take the place of the lines of the hand or tea grounds.

How can you find out whether a postage stamp has been used or not? Photograph it. If the postmark has been obliterated, the blue or green color will not make any impression on the plate, while the black traces of the obliteration will appear with great clearness. Even when the stamp has been well washed and no trace of the obliteration can be seen by the naked eye or through the microscope, the photograph will show very clearly the two concentric circles of the stamp, the date, and even the name of the locality.

There is another way, which does not belong to photography, but it is more precise. "It consists," Messrs. Renard and Lebarre write, "in plunging the stamp for a few seconds into a boiling solution of five grains of caustic potash in one hundred cubic centimeters of a mixture of equal parts of water and alcohol. The blue or green color disappears completely; it is then washed in water, next in water acidulated with acetic acid, then in water again, and lastly, carefully dried. On the discolored face of the stamp the marks of the obliteration can be discerned very plainly." This process is more sensitive than the preceding. Two stamps, which indeed had not disclosed anything by the photographic method, showed after the treatment by potash traces of the obliteration. The only inconvenience of this method is that it changes the stamp, which the experiment by photography does not disturb; so it is wise not to try this unless the photographic trial has given no result. When the stamp proves to have been a good one, we shall certainly regret our curiosity.

In closing this review, let us cite M. Zenger's experiences. He had the novel idea of photographing darkness. Two hours before midnight he placed himself before a window opening on the Lake of Geneva, and pointed his camera at—what he did not see. In developing the plate, he perceived with astonishment that the lake and Mont Blanc were reproduced. M. Zenger probably did not know the fact that for some time stars invisible to the naked eye had been photographed, and that microscopic photography reveals everyday details that visual acuteness would be incapable of discovering.

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A NEW COMPOUND LOCOMOTIVE.

To gain at one step greater simplicity with increased efficiency is invention of the highest order. It is often easier to arrive at results through complexity of parts than to reduce an invention to the fewest and simplest elements.

These truisms find no better illustration than that afforded by the development of the compound locomotive. After the question of economy was settled, there still remained doubts as to its utility, on account of complications arising from the use of auxiliary valves. All objections of this kind have now been disposed of by the invention by Mr. K. Golsdorf, of Germany, of a compound locomotive without starting mechanism. This engine has no moving parts additional to those found on every locomotive. The valve seat is of the ordinary description, with the exception of a small port in line with the inlet port, but not connected directly therewith, and the valve does not differ from the ordinary slide valve, except in having a central cross bar for covering the small auxiliary port, to which reference has been made. The small ports upon opposite ends of the valve seat are connected with pipes leading to the live steam pipe of the locomotive. When the locomotive is started and steam follows the piston through the greater portion of its stroke, live steam is admitted through the small auxiliary port to the steam chest, whence it flows through the inlet port to the cylinder. When, through the adjustment of the link movement, the throw of the valve is diminished, the supply through the small auxiliary port is cut off by the valve and the bar across the face of the valve, the latter at all times keeping the steam from passing directly to the exhaust port under the valve. The supply of live steam to the low pressure cylinder is regulated so as not to produce undue strain on the moving parts. It is obvious that, in other respects, the engine does not differ from a simple engine.

The first compound locomotive constructed upon this principle was erected in the locomotive shop at Wiener-Neustadt for the Imperial and Royal Austrian State Railway. It completely met the expectations of the builders, and the efficiency and consumption of fuel were so much in favor of this compound engine that further orders were placed. Toward the latter part of 1893 there were eight of these locomotives in service, and early in 1894 there were nineteen. Occasional examinations of the valves of these engines show that the wear is normal, the valve faces being always unexceptional. The auxiliary ports in the valve case of the low pressure cylinder, as well as the rib in the valve, showed that the openings are closed perfectly steam tight at the normal cut-off of about 50 per cent. Compared to ordinary locomotives, the exhaust is considerably softer and there is no conveying of cinders to the smoke box by way of the boiler tubes.

For information in regard to the Golsdorf we are indebted to the Nathan Manufacturing Company, 92 and 94 Liberty Street, New York City.

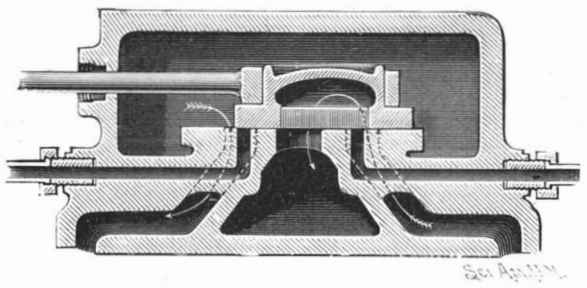

Fig. 2.—ARRANGEMENT OF THE VALVE AND PORTS, LOW PRESSURE CYLINDER.

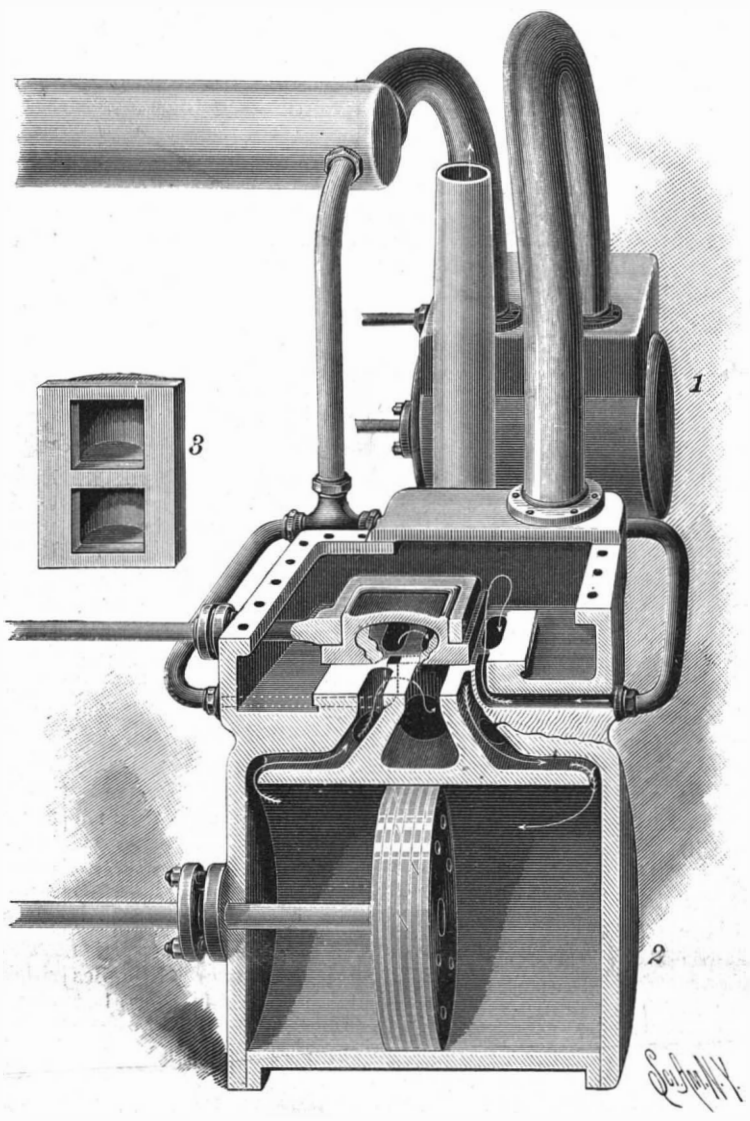

Fig. 3.—LONGITUDINAL SECTION THROUGH VALVE CHEST AND PORTS, LOW PRESSURE CYLINDER.

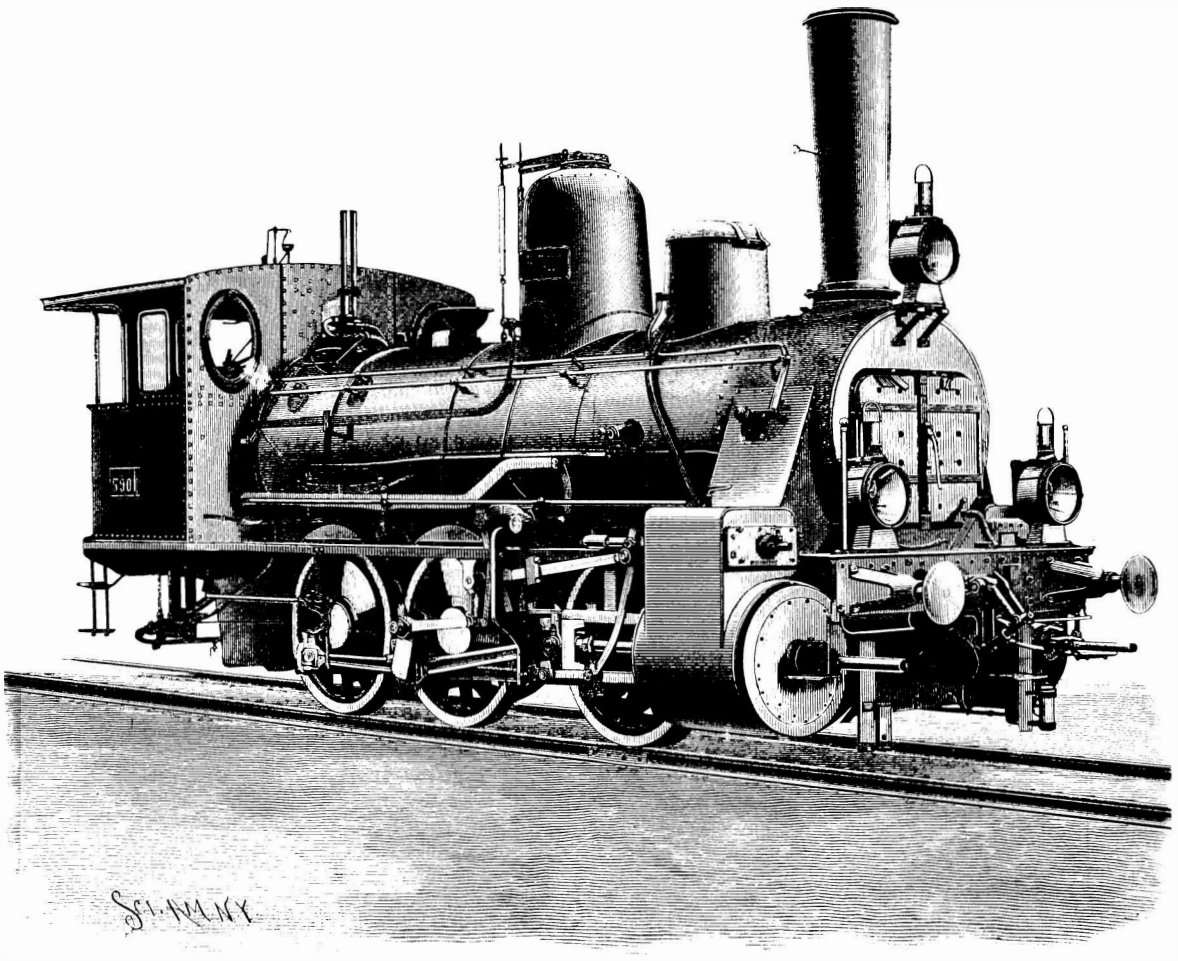

Fig. 1.—GOLSDORF'S COMPOUND LOCOMOTIVE.

Miscellaneous Notes.

Gigantic Leaves.—Palms have the reputation of possessing the largest leaves. Those of the *Quaja* palm of the Amazon measure sometimes 18 feet in length and are almost equally broad. The natives make tents of them. The leaf of the cocoanut is nearly 30 feet long. A single leaf of the parasol magnolia, of Ceylon, may shade fifteen or twenty persons. One of these carried to England measured nearly 35 feet. The largest leaf grown in temperate climates is that of the *Victoria regia*, which is sometimes 7 feet in diameter.

The Dualism of Amphibians.—It has been noticed that certain amphibians have a marked preference for one of the two *media* in which they live. The triton and the salamander, for instance, prefer the air, while the frog chooses one or the other, according to the atmospheric conditions. M. Dessart has found that the aquatic kinds perspire more and respire less than the terrestrial kinds, and he concludes that there is an antagonism between these two functions, by which the *habitat* is finally determined. If an aquatic species is placed in the air, its perspiration is increased and it returns to the water to counteract the excess; while, on the contrary, a terrestrial species placed in the water perceives that its respiration is diminishing and is forced to return to the air to avoid asphyxia.

The Odor of Plants.—Le Mechan's Monthly says that among the hundred thousand plants catalogued by botanists only a tenth exhale any odor. Of the fifty species of mignonette officially recognized, one only, that of our gardens, has an odor; and among the hundred varieties of violets, scarcely twelve have the exquisite perfume which we know. In general, the proportion of plants without odor to the fragrant ones is a hundred to one.

Meteors and Stellar Scintillation.—The theory is advanced by S. E. Christian, in *Popular Astronomy*, that stellar scintillation is caused largely by inconceivable numbers of small meteoric bodies, which are constantly passing between the stars and our earth. Momentary occultations of the stars by these bodies, which are revolving outside of our atmosphere, would certainly occur if these bodies were numerous enough, and recent investigation seems to point to the fact that they are.

Flexible Stone.—It may be safely said that no specimen in a geological collection is more curious than the bar of flexible sandstone, which can be bent with less pressure than that required to bend a piece of wet leather of the same size. In an article upon the subject in the *Mineral Collector* we are told that "when a thin slice of the stone is looked at under a lens, by transmitted light, the fragments are seen to be locked together like the parts of a section puzzle toy, fixed, but only loosely. The simplest way of explaining how this stone was formed is to say that the grains of sand were once cemented firmly together by another material, which has been partly dissolved, leaving countless natural ball-and-socket joints of jagged shape behind."

Rice Culture in Madagascar.—The cultivation of rice is highly developed in the interior of the island, but much less along the coast, where the lazy, careless natives find the land more fertile and the temperature more favorable. In some places, as in the neighborhood of Tananarive, immense marshes, subject to annual inundations and the source of malignant fevers, have been transformed into rice fields.

In the mountainous parts the rice fields are in terraces on the slopes of the mountains and the hills or in the high valleys. The water coming upon the high ones, passes successively to each level. There are some remarkable works of this kind, and one often sees these tiers of rice fields raised to the very summit of the high mountains, where the water is conducted by means of little canals, running at the flank of the declivities and bringing the water frequently several kilometers.

Finger-prints as Means of Identification.—Mr. Francis Galton, as the result of his investigation of anthropometry, affirms that "the patterns of the papillary ridges upon the bulbous palmar surfaces of the terminal phalanges of the fingers and thumbs are absolutely unchangeable throughout life, and show in different individuals an infinite variety of forms and peculiarities. And these are the two most important essentials that any method of identification could have. The chance of two finger-prints being identical is less than one in sixty-four thousand millions. If, therefore, two finger-prints are compared and are found to coincide exactly, it is practically certain that they are prints of the same finger of the same person; if they differ, the inference is equally certain that they are made by different fingers."—*Lancet.*

To determine how much coal a bin will hold, calculate 37½ cubic feet to every ton of 2,000 pounds. This rule applies substantially to either soft or hard coal.

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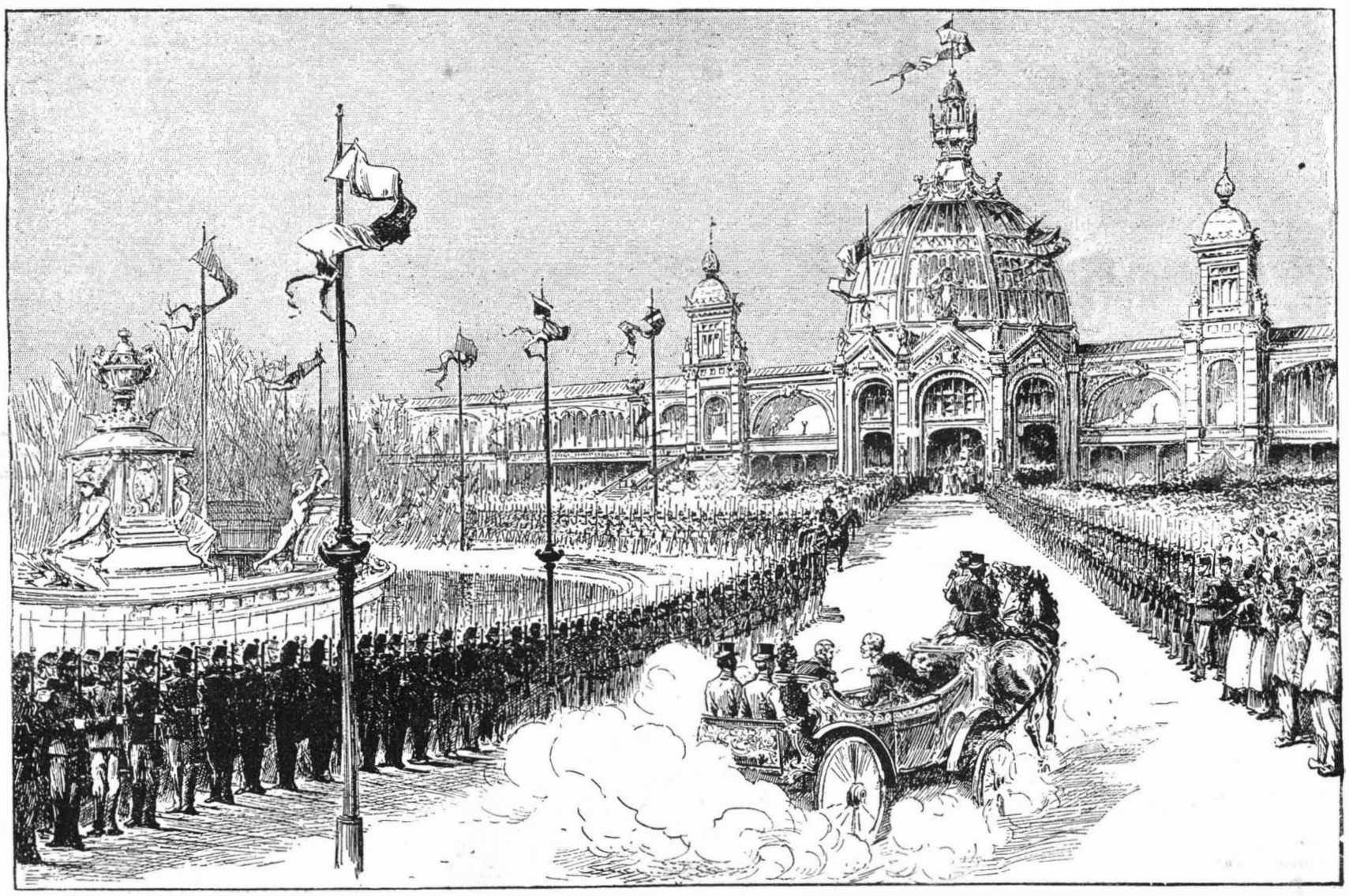
OPENING OF THE INTERNATIONAL EXHIBITION AT ANTWERP.

The International Exhibition at Antwerp was opened on the 5th of May, with great *éclat*. The King and Queen of the Belgians, accompanied by the court, came up from Brussels in a special train and were received by the Count of Flanders and an assemblage of the people, sixty thousand in number. Our engraving shows the appearance of the front of the Exhibition Building on the arrival of the royal party. The Exhibition grounds are 200 acres in extent and are filled with many beautiful buildings. They include halls for exhibiting industrial and commercial products, machinery, electrical appliances, fine arts, and the various sciences. The buildings are of iron and steel, roofed with zinc. The Royal Society of Fine Arts has a splendid building for the exhibition of paintings, sculpture, engravings, and architecture, in which contributions by all the principal European artists have been gathered. Among other subjects are reproductions of the mediæval buildings for which Antwerp was formerly noted; the drawbridge of the Kitbort Gate is shown. The original stone pillars belonging to the gateway have been preserved and are here put in place. Many other wonderful exhibits of the olden times are shown. Added to these are modern improvements, modern machinery, post office exhibits, telegraphs, telephones, electrical lights and mechanism. One of the most interesting exhibits is the Castle in the Air, which consists of an enormons balloon attached to the ground by cables. Passengers can ascend in the balloon and take a wonderful view of the surrounding country. Many of the most prominent exhibits of Chicago have been transferred to Antwerp. The United States is well represented. The American building is one of the finest of the foreign structures; the dimensions are 150 feet by 240 feet. The facade is very beautiful; a broad marble stairway leads to a vestibule 110 feet wide. In this building a great many rare exhibits of American industry are shown. Among them is a model shoe factory in full operation. The American fire appliances are shown, comprising steam fire engines, ambulances, fire alarm and electrical devices used in connection with the fire departments. The United States government makes a very fine display. In the Antwerp exhibition, to many choice exhibits which were shown at Chicago are added wonderful collections of curious things from all parts of Europe, which, by reason of their delicate and precious character, were not transported to the American show. Altogether, the exhibition promises to be a great attraction during the present summer. It will close on November 12. We are indebted for our engraving to the *Daily Graphic*, of London.



OPENING OF THE INTERNATIONAL EXHIBITION AT ANTWERP, MAY 5 1894.

The Teeth and Civilization.

On May 8, Dr. Wilberforce Smith read a short communication before the Anthropological Institute on the teeth of ten Sioux Indians attached to the Wild West Show. His investigation showed that in regard to molars and premolars (the only teeth examined), these Indians were wholly free from caries. In the discussion which followed the reading of the paper, it was mentioned that the same fact was revealed in the skulls of the Fourth Egyptian Dynasty brought to England by Dr. Flinders Petrie, and in some skulls examined by Dr. Wilberforce Smith himself, which were derived from the ruins of Pompeii. The teeth of the Indians, both old and young, and those in the skulls just referred to, all showed more or less wear of the cusps, which is a most unusual circumstance in the teeth of modern civilized people, and it was thought that some difference in the food, or its mode of preparation, would be required to account for the absence of signs of wear in our time.

Now it has never been proved that the increasing prevalence of caries is due to weakness of the teeth owing to comparative disuse, but there is nevertheless great probability in the inference, especially as signs of wear and freedom from caries appear to occur together, and *vice versa*. There is, however, a further point in regard to the existing liability to the attacks of caries, which I think can be best explained by a transference of nourishment to other parts governed by the same nerves. On inquiry of several dentists, I find that the teeth most subject to decay are the molars, and of these the upper molars are more often attacked than those in the lower jaw. The molars of the upper jaw are fed by a branch of the fifth nerve, and in modern life this nerve has, perhaps, more strain put upon it than any other in the body. We use our eyes, partly supplied by the ophthalmic branch of this nerve, not at intervals, but often closely throughout a long day. And it seems, therefore, that with so many increasing calls on this bundle of nerve fibers, the filaments sent to the teeth are, by an automatic economy of expenditure, robbed of the energy necessary to perform their functions properly. The teeth through lack of use may not excite the nerves to natural action, and thus from both sides there is a failure of function, and the teeth are consequently more and more unable to resist the attacks of caries. I am disposed to attach some importance to this explanation, as I find that those who have great calls on their nervous energy are more liable to caries than people of quieter habit and slower temperament.

Dr. Wilberforce Smith mentioned the alarming increase of dental decay among hospital nurses, whose occupation is certainly one demanding a constant drain on their nervous energy. It was also noted that people in towns lose their teeth more rapidly than those living in the country, which also bears out the idea here suggested. On the other hand, the savage is seldom required to strain his facial nerves continuously for any length of time, and in reference to general nervous expenditure he enjoys long periods of rest which are wholly denied to the civilized man in towns. No doubt, in consequence of the excessive calls on our nervous energy, the distribution of it is undergoing modification in civilized man, and parts not used to any extent are being deprived of the supply necessary to healthy growth.

It is much to be feared that the teeth, though so essential to the welfare of the body, are in this predicament. But we are sadly in need of more definite information than is at present available, and it is partly in the hope that some of the readers of *Nature*, who have opportunities which I do not possess, may be induced to test this and other ideas relative to the increase of caries, that I have written on the subject. The whole question is at present much obscured by misconceptions due to ignorance. One fact, however, emerged only too clearly from Dr. Wilberforce Smith's investigation, namely, that while the grinding teeth of civilized men of middle age are either missing or practically useless for their purpose, the ancients enjoyed a perfect set of teeth till advanced years, and modern savages enjoy the same blessing. — *Arthur Ebbels, in Nature.*

Convention of American Society of Civil Engineers.

The American Society of Civil Engineers will hold their 26th annual convention at the Cataract House, Niagara Falls, N. Y., beginning at 10 a. m. on Wednesday, June 20, and ending on Monday, June 25. The programme, while not yet fully prepared, has been sufficiently developed to indicate that a most interesting convention is intended. At Niagara Falls the works of the power company and different mills established there will be visited. Arrangements will be made for special railroad rates and accommodation at the hotel. A special committee of the board of direction has been maturing the plans for some time past, and the president of the society has appointed the following local committee of arrangements:

W. A. Brackenridge, chairman; John Bogart, S. J. Fields, Edward B. Guthrie, Joseph Hobson, W. T. Jennings, W. C. Johnson, E. H. Keating, Albert H. Porter, Benjamin Rhodes, Pemberton Smith; Walter McCulloh, secretary.

A LITTLE carbolic acid added to the whitewash will kill the vermin in the henhouse.

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Correspondence.

A Black Calla Lily.

To the Editor of the Scientific American:

I saw in your last issue an account of the "yellow calla lily," which reminds me of two callas a jeweler in this city got among a lot ordered from the nursery. As no one in this section had ever seen or heard of them before, I will describe them. After keeping them for a few weeks they put out a bloom which was as black as night and had a very noxious odor, but in other respects are just the same as other callas. He removed them to his back yard, where they continue to bloom. Is there a scientific name for it?

Richmond, Ind. J. EDWIN WELLER.

Coal Ashes as a Fertilizer.

To the Editor of the Scientific American:

Querist 5996, No. 18 SCIENTIFIC AMERICAN, vol. lxx., asks: "Do coal ashes possess any value as a fertilizer?"

I answer yes. My father bought a tract of depleted or worn-out land. On returning from a neighboring market with his team he would bring a load of hard coal ashes, which he would spread upon the surface of said land in the fall of the year, and the succeeding summer it would invariably be covered with a thick growth of white clover. EDWIN LEACH,

A subscriber since 1846.

[Coal ashes have no direct value as a fertilizer. By lightening a clay soil they might do good, and clover itself is recognized as having a good effect on land.—ED.]

Snake and Blue Jay.

To the Editor of the Scientific American.

I witnessed a novel sight a short time ago, viz., the killing and eating of a snake by a blue jay. I am living in an oak grove here where Mr. Jay makes his home the year round. I sat watching one of them feeding a short time ago, in the grass, when I noticed he got excited from some object. With his feathers ruffled on his neck and head, and tail erect, he charged from the lower branch of an oak and made a vicious thump at something in the grass. Again and again he whacked at his snakeship, jumping from one side to the other as lightly as an expert "light weight." Then he picked the snake up in his bill, and with neck stretched, tried to carry him to a tree, but the snake was too much alive, and had to be dropped. Twice did this occur, when he finally got him to an oak limb, cut him in two, dropped one half and carried the other half to another tree and ate him. The snake was about ten inches long and three-eighths inch round. I was not more than thirty feet from the scene of battle and the whole thing was done in five minutes.

JOHN BURNS.

2026 Buchanan Street, Minneapolis, Minn.

The Forty-third Annual Meeting of the American Association for the Advancement of Science.

The American Association for the Advancement of Science will hold their forty-third meeting in Brooklyn, N. Y., from August 15th to the 24th, under the following officers:

President: Daniel G. Brinton, Media, Pa.

Vice Presidents: A. Mathematics and Astronomy—George C. Comstock, Madison, Wis.; B. Physics—William A. Rogers, Waterville, Me.; C. Chemistry—Thomas H. Norton, Cincinnati, Ohio; D. Mechanical Science and Engineering—Mansfield Merriman, South Bethlehem, Pa.; E. Geology and Geography—Samuel Calvin, Iowa City, Iowa; F. Zoology—Samuel H. Scudder, Cambridge, Mass. (resigned); G. Botany—Lucien M. Underwood, Greencastle, Ind.; H. Anthropology—Franz Boas, New York; I. Economic Science and Statistics—Henry Farquhar, Washington, D. C. *Permanent Secretary:* F. W. Putnam, Cambridge (office, Salem), Mass. *General Secretary:* H. L. Fairchild, Rochester, N. Y. *Secretary of the Council:* James Lewis Howe, Louisville, Ky.

The meetings of the different sections will be held in the buildings of the Polytechnic and Packer Institutes, the Art Association, the Long Island Historical Society, and the Academy of Music, which are near one another, and peculiarly available for the purpose.

The lanterns used in the lecture rooms of these institutions will be at the service of the speakers. Several excursions will be arranged for the geologists, mineralogists, engineers and others to the most interesting points about New York. The list of papers as far as published indicates a most interesting meeting.

Foot Bicycles.

An ingenious inventor has provided himself with a pair of bicycles for his feet. The wheels are about four inches in diameter and are strapped to his feet like skates. They have rubber tires and glide over the concrete pavement with great ease. They are very superior to the common roller skates and the owner moves along almost as fast as the bicyclist.

THE PERIODICAL CICADA, ALIAS SEVENTEEN-YEAR LOCUST.

BY C. V. RILEY

(*Continued from page 355.*)

OVIPOSITION.

The female oviposits preferably in the previous year's growth of oaks, but also in the twigs of a large number of other trees, some fifty having been recorded by myself and others, including our chief fruit trees, but very few evergreens. The eggs are laid somewhat obliquely in a double row, each row separated from the other by a portion of woody fiber, which is wider at the bottom than at the top. Each egg is of a pearl-white color, 1-12 of an inch long, and tapers to an obtuse point at each end. The life and moisture of the twig are necessary to the development of the egg, and it is a mistake to suppose that the mother insect severs the twigs. The dried leaves and twigs which are so abundant on the tips of the branches of our forest trees during a Cicada year are caused by the force of the wind breaking the twigs at the point where they have been sawed. The breaking is accidental and not essential. The proportion of broken or severed twigs, or twigs heavily charged with eggs, upon which the leaves prematurely dry and die, though it may be sufficient to give a withered appearance to the whole exterior of the tree, is but small compared with the thicker and stouter twigs which are punctured but do not break; and from past calculations I judge that about 90 per cent, and in many cases a larger percentage than this, of the eggs which hatch are laid in twigs which never break off. The external appearance of the punctured twigs is indicated at Fig. 1, while in Fig. 2 a single puncture is shown enlarged at *a* and sections of the same at *b*, *c*, and *d*.

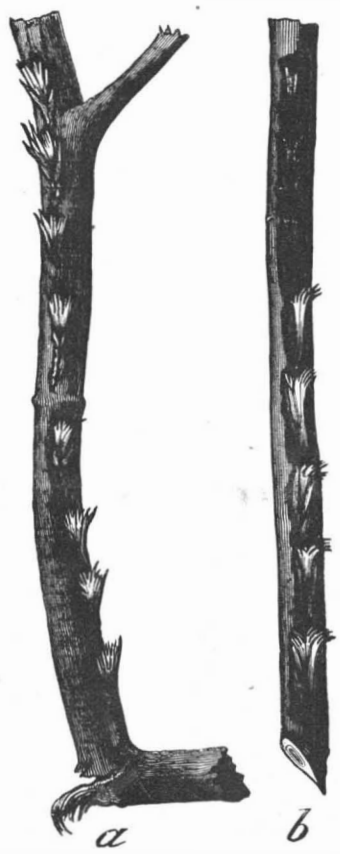

FIG. 1.—*a*, twig showing recent punctures, from front and side, and illustrating manner of breaking; *b*, twig showing older punctures, with retraction of bark, and more fully displaying the arrangement of fibers. Natural size.

LARVAL DEVELOPMENT.

The long period of underground development of both the 13-year and 17-year races has been thoroughly established on chronological and historical data covering nearly two centuries. There is, however, chronic skepticism as to facts which are so exceptional, and this is especially true as regards Europeans. The desirability of experimental proof, therefore, has long been felt, and I am happy to state that since 1868 I have been able to watch the larvæ from two distinct broods annually, not in confinement, for this is difficult, but by causing a number of eggs to hatch under a particular tree, and then annually digging and observing the rate of growth and changes that take place in the larvæ. There are six well marked subterranean stages which can be easily identified by the changes in structure. There may be more than six moults, as this is a matter that is difficult to determine, and in an insect which develops so slowly exuviation may take place more often than is usual among insects. These well marked stages are characterized by differences in the antennæ and particularly in the structure of the front legs. Four of these stages are larval, and without entering into technical detail, it may be stated that the chief interest of these stages lies in the fact that the newly hatched larva, as it comes from the egg and drops gradually to the ground (see Fig. 3), has the front tarsi fully developed, since it must crawl over the ground and has use for the front feet. After the first moult these front feet, being of no service, are lost, and the femora and tibiæ become gradually enlarged to fit the insect for a fossorial existence, these legs reminding one very strongly, in fact, of those of the mole cricket. The last two stages may be called pupal, and the interesting fact may be noted that in the pupa state the front tarsi or feet are regained, but are functionless while the insect remains underground, being folded back on the tibiæ, and are only brought into use after the pupa begins to crawl over the ground or mount some stem or tree for its final transformation. No similar case is found among vertebrate animals of a creature born with certain important structures which it subsequently loses and then regains according to the requirements of its life, though many similar instances are known among invertebrates.

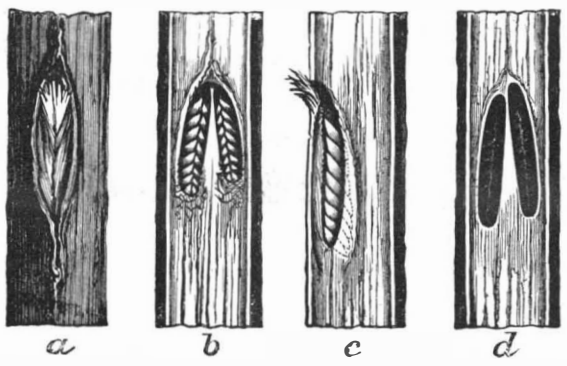

FIG. 2.—*a*, recent puncture, front view; *b*, same, surface removed to show arrangement of eggs, from above; *c*, same, side view; *d*, egg cavity exposed after eggs are removed and showing the sculpture left by the ovipositor. All enlarged.

FIG. 3.—Newly hatched larva. Greatly enlarged.

SONG NOTES OF THE CICADA.

There are three prevalent notes which, in their blending, go to make up the general noise which, on approaching an infested woods, is a compromise between that of a distant thrashing machine and a distant frog pond. The first is that ordinarily known as the phar-r-r-r-r-r-aoh, somewhat variable in pitch and volume, according to the conditions of the insect and the atmosphere. Its duration averages from two to three seconds, and the *aoh* termination is a rather mournful lowering of the general pitch. The rolling nature of the note, when heard in sufficient proximity, recalls more the croaking of certain frogs than anything else. The second note, and the loudest, is that described by Fitch as represented by the letters *tsh-e-e-E-E-E-E-e-ou*, uttered continuously and lasting from two to three seconds, though occasionally longer, and repeated at intervals of about every five seconds. This note is chiefly made during the height of the season, when the insects are numerous. It is also made in unison by all the males on a given tree. The third note is what may be called an intermittent chirping sound, being a series of 15 to 30, usually about 22, sharp notes, sometimes double, lasting in the aggregate about five seconds. Readers of the SCIENTIFIC AMERICAN hardly need to be told that it is only the male which produces this song, a fact well known to the ancients and well voiced by the Rhodian bard Xenarchus in the somewhat hackneyed lines:

Happy the Cicadas' lives,
Since they all have voiceless wives.

ENEMIES OF THE CICADA.

In its adult state the Cicada has many enemies, as almost all predaceous animals, including many birds, pursue them, particularly when they are freshly issued from the pupa. The eggs are also much injured by mites, and the mature insect, when old, is affected by the fungus *Mesospora cicadina* Peck, which is found in the shape of a yellow-brown or clay-colored powder permeating all parts of the body, and often entirely filling the abdomen. This fungus is most often seen in the males. It is interesting to note, however, that no true insect parasite has yet been discovered as affecting this insect, a fact undoubtedly due to its long subterranean life, which is so exceptional and would preclude the breeding of any of the ordinary parasites upon it. We may, in fact, find in this some explanation for this long, exceptional subterranean existence.

SUPPOSED STING OF THE CICADA.

During every Cicada visitation the newspapers publish accounts of injury to children or other persons by the sting of the Cicada. It suffices to say that no well authenticated cases of stinging have ever been recorded, and that, while the insect has a strong beak by which it can puncture twigs and draw sap, no one has ever known it to be inserted in flesh, though hundreds of persons have handled the insects and endeavored to cause them to puncture. The same may be said of the ovipositor, which, though capable of puncturing the twigs of trees, can only be worked where the insect can obtain perfect repose and a proper purchase against a sufficiently hard and unyielding surface. The best explanation of the newspaper accounts is that the stinging is done by one of the large Digger wasps belonging to the genus Stizus, which is known to use the Cicada as food for its young and to carry them in its heavy flight from some shrub or tree to the ground in the neighborhood of its burrow. Our periodical Cicada, however, in most latitudes, is about to disappear before the Stizus is seen, though exceptionally the two are contemporaneous.

THE CICADA VS. CIVILIZATION.

The following quotation from the writer's report as entomologist of the Department of Agriculture for 1885 is just as applicable to-day as when it was written:

"That this insect, in its distribution and its num-

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bers, has been and is being seriously affected by our civilization must be apparent to every observer. The records show that the numbers have decreased in the successive appearances of certain broods, owing largely to the presence of our domestic animals in the woods. Then, again, the clearing of land and the building of towns and cities have all had their effect upon the increase of this Cicada. There are doubtless many places in Brooklyn, N. Y., where the insect appeared seventeen years ago in which there will be none the present year. And similarly I opine that whereas around every tree that has been planted more than seventeen years ago the insect is now abundant in Washington, it will scarcely be noticed in any part of the District seventeen years hence. I base this opinion on a new phase in the Cicada history, viz., the presence of the English sparrow. It is the first time, perhaps, in the history of the world that *Passer domesticus* has had an opportunity of feeding upon this particular brood of *Cicada septendecim*, and so ravenously and persistently does this bird pursue its food that the ground is strewn with the wings of the unfortunate Cicada wherever these have been at all numerous; so that, considering the numbers of the sparrows and their voracity, very few of the Cicadas will be left long enough to procreate and perpetuate the species in this district."

SOME REFLECTIONS ON THE POPULAR NAME.

All the leading American writers upon this insect have dwelt upon the necessity of applying correct popular terms to it, since the vulgar name of "seventeen-year locust" leads to a great deal of confusion and causes unnecessary apprehension. The term "locust" in all other English-speaking countries but our own is applied to certain devastating insects of the order Orthoptera and of the family Acrididæ, to which we generally apply the popular term "grasshoppers." Some of the species are migratory and have been renowned since biblical times for their destructiveness. Biblical and general usage in other countries should serve to fix this term upon this family of insects and disconnect it from the Cicada under consideration, which produces no such disastrous consequences. "Cicada" is short and euphonious, and might be adopted into popular language as Phylloxera, Geranium, etc., have been, while a term in quite common use among entomological writers for the family of Cicadas is "harvest fly."

A BICYCLE ambulance is one of the latest inventions, and consists of a bicycle with an ambulance attached. The stretcher is fastened to the top of the bicycle, and the wounded or sick person lying on the stretcher can then be rolled along in a very gentle and safe manner.

THE HAUNTED SWING.

The supreme happiness of sitting in a swing which apparently whirls around its points of support, giving the occupant what is most properly described as a new sensation, may now be enjoyed by all. A patent recently granted to Amariah Lake, of Pleasantville, N. J., describes the illusion which we illustrate. It is termed the haunted swing, and has been in most successful operation at Atlantic City and at the Midwinter Fair near San Francisco. Those who are to participate in the apparent gyrations of the swing—and there may be quite a number who enjoy it simultaneously—are ushered into a small room. From a bar crossing the room, near the ceiling, hangs a large swing, which is provided with seats for a number of people. After the people have taken their places, the attendant pushes the car and it starts into oscillation like any other swing. The room door is closed. Gradually those in it feel after three or four movements that their swing is going rather high, but this is not all. The apparent amplitude of the oscillations increases more and more, until presently the whole swing seems to whirl completely over, describing a full circle about the bar on which it hangs. To make the thing more utterly mysterious, the bar is bent crank fashion, so that it seems demonstrably impossible for the swing to pass between bar and ceiling. It continues apparently to go round and round this way, imparting a most weird sensation to the occupants, until its movements begin gradually to cease and the complete rotation is succeeded by the usual back and forth swinging, and in a few seconds, as the children say, "the old cat dies." The door of the room is opened and the swinging party leave. Those who have tried it say the sensation is most peculiar and the deception perfect.

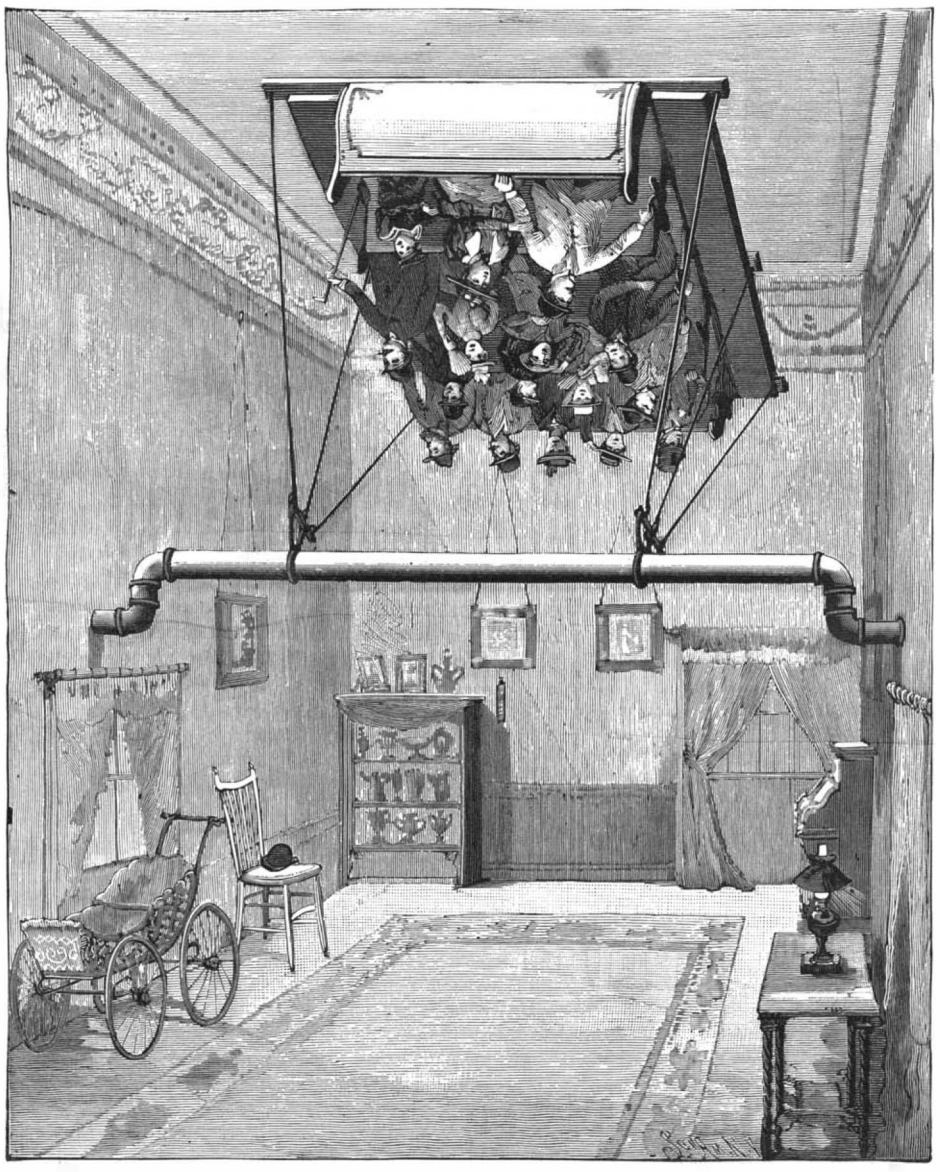
The illusion is based on the movements of the room proper. During the entire exhibition the swing is practically stationary, while the room rotates about the suspending bar. At the beginning of operations the swing may be given a slight push; the operators outside the room then begin to swing the room itself, which is really a large box journaled on the swing bar, starting it off to correspond with the movements of the swing. They swing it back and forth, increasing the arc through which it moves until it goes so far as to make a complete rotation. The operatives do this without special machinery, taking hold of the sides and corners of the box or "room." At this time the people in the swing imagine that the room is stationary while they are whirling through space. After keeping this up for some time, the movement is brought gradually to a stop, a sufficient number of back and forth swings being given at the *finale* to carry out the illusion to the end.

The room is as completely furnished as possible, everything being of course fastened in place. What is apparently a kerosene lamp stands on a table, near at hand. It is securely fastened to the table, which in its turn is fastened to the floor, and the light is supplied by a small incandescent lamp within the chimney, but concealed by the shade. The visitor never imagines that it is an electric lamp, and naturally thinks that it would be impossible for a kerosene lamp to be inverted without disaster, so that this adds to the deception materially. The same is to be said of the pictures hanging on the wall, of the cupboard full of chinaware, of the chair with a hat on it, and of the baby. All contribute to the mystification. Even though one is informed of the secret before entering the swing, the deception is said to be so complete that passengers involuntarily seize the arms of the seats to avoid being precipitated below. Our drawings are prepared from sketches made at the Midwinter Fair in California.

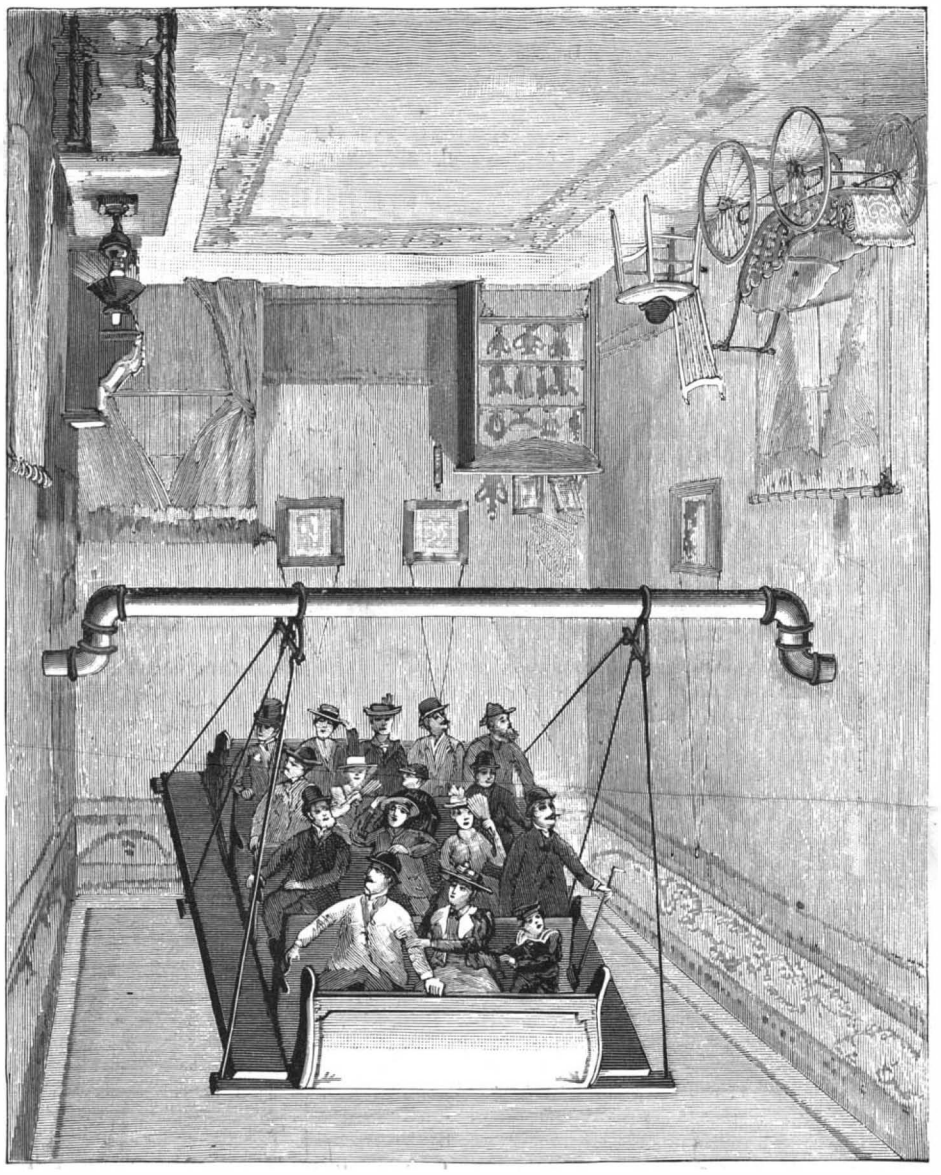
The Strike at Pullman.

The employes of the car works of Pullman's Palace Car Company, at Pullman, Ill., struck May 11, and the shops have been closed until further notice. According to the *National Car Builder*, the men demanded the restoration of the rates of pay for piecework to what these had been previous to the reduction made on account of the falling off of business. A day or two before the strike President Pullman personally addressed a gathering of the men and gave them some plain statements of the conditions which made low wages for the present necessary. At the commencement of the depression last year the company employed at Pullman 5,816 men and paid out in wages there $305,000 a month. Negotiations that were then pending for new work were stopped, orders were canceled, and it became necessary to lay off a large number of men in every department, so that by the first of November, 1893, there were only about 2,000 men in all departments, or a little over one-third of the normal number.

In the effort to keep the shops running and the workmen employed the company made lower bids than were ever before known, and by this means secured work enough to increase the force from 2,000 to 4,300 men, which was the number employed at the time of the strike. This was done by the company eliminating from its estimates the use of capital and machinery, and in many instances going below that and taking work at a considerable loss; as much in one particular case as $12 per car and in another $79 per car. The Detroit shops of the company were closed in order to provide work for the men at Pullman, and $160,000 was spent since last August in carrying out a system of improvements in the town, which gave work to many.



ILLUSION PRODUCED BY A RIDE IN THE SWING.



TRUE POSITION OF THE SWING

THE HAUNTED SWING—A CURIOUS ILLUSION.

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RECENTLY PATENTED INVENTIONS.

Engineering.

WIND JACKET FOR BLAST FURNACES.—Louis B. Walker and John Murphy, Globe, Arizona. According to this invention a wind jacket surrounds the crucible, there being above the jacket a wind box from which lead tuyeres, while a blast supply pipe is so connected with the wind box that the air will be caused to travel around the crucible in the wind jacket and then pass upward to the wind box and the tuyeres, whereby the blast will be heated previous to entering the wind box and at the same time keep the crucible cool to prevent overheating and save wear and tear on the furnace.

ANGLE PLATE FOR BOILER FRONTS.—George Fox, New York City. This is an improvement in hollow arches or fronts for steam boilers and boiler fire boxes, the hollow water front being constructed, according to this invention, in right-angular form, and arranged to cover a portion of the top of the fire box, and all of its end above the grate, save the door space. With this improved angle front it is also unnecessary to place any mason work between the front and the grate bars or furnace.

Mechanical.

WRENCH.—Herrmann Krebs, San Pedro, Cal. This is an improvement in what are known as alligator wrenches, and is especially adapted as a pipe wrench. The fixed jaw forms a portion of the handle, which has a longitudinal channel and a transverse opening, while the second jaw has an extension turning in a recess in the fixed jaw, whereby the second jaw is fulcrumed, an adjusting screw revolving in the channel of the body having a head entering the opening in the body of the pivoted jaw, the screw being manipulated by an adjusting nut. The tool has but few parts, is strongly made and easily operated.

NUT LOCK.—Henry J. Van Nest, Florence, Col. According to this invention a swinging key is provided with a projecting screw thread section on its face and with an attached branch spring on one side, and also with a lug adapted to enter a hole in the nut to which it is applied, to prevent or lock a nut from unscrewing on its screw bolt, stud or rod, by friction against or biting into the thread, freely allowing the nut to be turned in the other direction to screw it up.

TENSION DEVICE FOR SPINNING FRAMES.—Robert Atherton, Paterson, N. J. This is an attachment whereby the tension between the drum and spindles is automatically adjusted, and changes in the length of the spindle driving bands is instantly compensated for. It also provides reliable means for giving a uniform speed to series of spindles on the spinning frame, avoiding excessive tension in the driving belts, and reducing to a minimum the friction of the spindles in their supporting bolsters.

Agricultural.

GRAIN SEPARATOR.—Joseph H. Creter, Newcomerstown, Ohio. This is an improvement upon a formerly patented invention of the same inventor, providing guides for the driving rods or pitmen of the screen, in the location of the gearing, the shape of the valves in the various flues or ducts of the machine, and in the construction of the deflector carried by the machine, the deflector being made in sections, one section having yielding or adjustable connection with the other. The construction of an upper air flue, directing air above the screen, is such as to give the machine power, by condensation and pressure, to work with uniformity and separate any kind of grain or seed, whether light or heavy.

CHURN.—James P. Bolding, Forney, Texas. This churn comprises a platform carried by a post which may turned, there being on the platform a vessel in which is a dasher turned by a shaft on which is wound a band, a lever being connected at opposite sides of its fulcrum with the inclined ends of the band. By the operator swinging the lever forward and backward rotary motion is given to the shaft, turning the dasher, by which the churning is quickly effected.

SUGAR CANE TRANSFERRING DEVICE.—Christian D. Armstrong, St. Bernard, La. To conveniently and easily transfer the cane from the field wagons to the cars running to the mill, this inventor has devised a platform with flanged extension pivoted to a post, a shaft above the platform carrying drums with ropes connecting with the side of the platform opposite the extension, while a hoisting drum on one end of the shaft is connected by a rope with a draught beam. The platform normally rests on the ground, so that field wagons may drive on it to dump the cane.

ELEVATOR.—William H. McCoy, Los Angeles, Cal. This is a vacuum elevator, more especially designed to raise water for irrigating or other purposes, It has cylindrical water receptacles connected with a water supply, a steam cylinder connected with the receptacles, with a piston admitting steam alternately, and pipes connecting the receptacles with the ends of the steam cylinder, while the valves controlling the admission of water to the pipes are controlled by the rise and fall of the water in the receptacles, one receptacle being filled while the other discharges, and vacuums being alternately formed after the water is discharged to draw a new supply into each receptacle.

CAMERA SHUTTER.—William J. McCollom, Swaledale, Iowa. This is a simple and inexpensive shutter to be used with an ordinary camera. It is arranged to close from around the lens tube toward the center and open in the reverse direction, thus preserving the circular shape of the lens opening and preventing the light from striking unevenly on the sensitive plate. It has but few moving parts, moving with but little friction, the parts being counterbalanced to be operated with great facility, and pneumatic means being provided for opening and closing the shutter.

CONDENSER AND DRIP FOR GAS SERVICE PIPES.—Albert H. Gindele, Jersey City, N. J. Between the gas meter and the service pipe is a condenser which has spaced baffle plates projecting from opposite sides, and has its upper end connected with the meter pipe, while a fitting secured to the service pipe and to the lower end of the condenser is provided with a drip chamber in its lower portion. The device is designed to arrest the water of condensation that may be in illuminating gas carried into house service pipes, and prevent the deposition of condensed water in the meter.

DATING AND STAMP CANCELING MACHINE.—James B. McElrath, Centre, Ala. This is an inexpensive machine, adapted to be operated by foot power or other means, for rapidly dating and canceling postage stamps on letters, cards or packages. The machine will operate on letters or thin cards as effectively as on thicker packages, the mail matter operated upon being discharged from the machine in a box-like space at its rear, to be thence transferred to the assorting tables or mail bags.

PICTURE HANGING DEVICE.—Henry Redmond, New York City. The body of this device consists of a socket attached to one end of a pole, there being at one side arms for manipulating the cord or wire of the picture frame, whereby one, without the assistance of a step ladder, may readily hang a picture or remove one from the wall. The implement may also be employed to readily place in position in the wall a picture hook, or other similar support, or readily remove such support from the wall.

SLIDING WINDOW OR DOOR.—Carl Summermann, Munster, Germany. This invention provides a horizontally sliding and air-tight closing sash, casement or door for windows, etc., which may be readily opened without interfering with curtains or anything on the window sill. The sash is adapted to travel on an essentially horizontal guideway, having portions that deviate vertically and laterally from the main portion of the guideway, whereby the sash is brought tightly against the frame when the door or window is nearly closed.

GATE.—John P. Van Nada, Petersburg, Ind. This is an improvement upon a formerly patented invention for swing gates, whereby levers will be dispensed with, and a simple and economic opening device provided, which may be conveniently operated from either side. In opening or closing the gate the operator is, by this improvement, relieved of considerable of the weight of the gate.

FOLDING CRIB.—Sarah C. Neal, New York City. This crib is composed of a skeleton frame to which is attached a pendent netting of canvas or similar material. The bottom of the body is usually made in two sections connected by a hinge, the bottom of the body being upholstered, or a sectional mattress being employed if desired.

POCKETBOOK FRAME, ETC.—Louis B. Prahar, Brooklyn, N. Y. This inventor has designed an improvement in corners or frames for pocketbooks, book covers, etc., whereby the frame or corner is made in two sections, a body section and a binding section, employing two differently colored metals at a minimum cost, but so that when the frame is in position upon the article it will have the appearance of a one-piece frame.

SCALPEL.—Joshua W. Jones, New York City. In the construction of this implement the blade is so formed that it has a cutting surface at the heel and at the point, in addition to the ordinary cutting surface, the cutting surface at the point being carried a certain distance along the back, and there being no angles in the heel and point cutting surfaces.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS AND PUBLICATIONS.

HOW TO BECOME A SUCCESSFUL ELECTRICIAN. By T. O'Conor Sloane, Ph.D. New York: N. W. Henley & Co. 1894. Pp. 189. Price $1.

This work is designed for the numerous class of young men who desire to enter the electrical field, yet who feel unable to take a regular college course. Its object is to indicate a course of study which can be followed by the graduate of the workshop and of the public school, the point being repeatedly made that a little thoroughly learned is worth more than a great deal that is merely skimmed over. Mathematics, physics, chemistry, mechanical engineering, and drawing, each receive a chapter, in which the minimum amount that should be well learned is given, and the advisability of learning more is pointed out. Electrical work at home, factory and shop work for students, and college education are examples of other topics. The different fields of work are depicted, the art of inventing, original investigation and reading are other chapter subjects. The chapters on success and ethics give the broad view of how a professional man should regulate his conduct. The book will be warmly received, and we trust will fill what has long been an urgent need in the literature of the profession.

PHOTOGRAPHISCHES NOTIZ- UND NACHSCHLAGEBUCH FUR DIE PRAXIS. Von Ludwig David und Charles Scolik. Mit 7 Kunstbeilagen. Vierte umgearbeitete Auflage. Halle a. S.: Druck und verlag von Wilhelm Knapp. 1894. Pp. xvi, 221.

As we have before had occasion to say in noticing this annual publication, it is distinguished by the most beautiful examples of photographic work, in themselves enough to entitle the volume to especial consideration by the photographer. It contains numerous formulæ and pages for notes, and is in very convenient shape. It is an excellent example forits type of publication.

SIMPLE EXPERIMENTS FOR SCIENCE TEACHING. By John A. Bower. London: Society for Promoting Christian Knowledge. New York: E. & J. B. Young. 1894. Pp. 164. No index.

This attractively printed little work is in one respect sad, as it is designed for one of the multifarious sharply defined English courses. It is, in other words, written to enable students to pass a definite examination. This of course limits the treatment of the subject and to that ext nt impairs its value from the more enlightened standpoint of general literary value. It is divided into twenty lessons each of ten experiments, and the experiments are so simple as to be easily performed. The author in his efforts to treat the subject familiarly uses terms which would be better excluded. Nothing is gained by calling carbon dioxide chalk gas. Other minor inaccuracies may be noted, such as speaking of the action of a lime kiln or limestone as one of simple ignition, leaving out of account the reducing action of the carbon of the fuel. There is an index of cuts, but no general index.

THE GEM ENCYCLOPEDIA. Chicago: Laird & Lee. Pp. 448. Flexible cloth 25 cents, stiff cloth 50 cents. No index.

The least that can be said of this little compendium is that it gives an immense amount of information for the price and for its size. How any item is to be found without an index is one of the things that surpasses the understanding; the book however may fill many a half hour of leisure time.

THE CENTURY MAGAZINE. November, 1893, to April, 1894. The Century Company, New York.

The semi-annual volumes of this most richly illustrated of magazines are always a delight, for one hardly realizes, in looking over the current numbers, month by month, what a wealth of interesting reading matter, some of it of the highest permanent value, is accumulated, in a form to make an exceedingly attractive addition to any library. Among some of the notable features of the last volume are original papers and pictures of the great Napoleon, Bible Exploration and the Assyrian Monuments, a series of articles on Abraham Lincoln and on James Russell Lowell, Bismarck at Friedrichsruhe, Earthquakes and how to Measure them, Conkling and Garfield, a Pilgrimage to Lourdes, a number of papers on great musicians, and another series on great painters, the illustrations in each case being supplied with a lavish hand, and the printing in the exquisitely beautiful style of the De Vinne Press.

SCIENTIFIC AMERICAN BUILDING EDITION.

JUNE, 1894.—(No. 104.)

TABLE OF CONTENTS.

1. Elegant plate in colors showing a cottage at Rochelle Park, recently completed for Dr. N. M. Beckwith. Floor plans and two perspective elevations. Cost complete $11,000. Mr. G. K. Thompson, architect, New York. A very unique design in the old Dutch style of architecture.
2. Plate in colors showing a handsome residence at Evanston, Ill., recently completed for H. D. Cable, Esq. Two perspective views and floor plans. Messrs. Raeder, Coffin & Crocker, architects, Chicago, Ill. An elegant design.
3. An attractive residence at Hartford, Conn., recently completed for Albert S. Cook, Esq. Cost $7,500 complete. Mr. A. U. Scoville, architect, Hartford, Conn. A pleasing and attractive design, two perspective views and floor plans.
4. Perspective elevations and floor plans of a residence at Portchester, N. Y., recently erected for William Mertz, Esq. The design is severely classic in its treatment and illustrates the American progress in architecture. Mr. Carl Volz, architect, New York.
5. A residence in the colonial style recently erected at Ashbourne, Pa., for Addison Foster, Esq. Perspective elevation and floor plans. Estimated cost $5,500. Mr. Samuel Milligan, architect, Philadelphia, Pa.
6. A residence at Freeport, L. I., recently completed for J. E. Brown, Esq. Perspective elevations and floor plans. Cost complete $6,950. An attractive design.
7. The dwelling of J. S. Benner, Esq., at Reading, Pa. Three perspective views and floor plans. Mr. Geo. P. Barber, architect, Knoxville, Tenn.
8. A colonial cottage recently completed for Howell E. Beane, Esq., at Ashbourne, Pa. Cost $4,000. Perspective elevation and floor plans. Mr. Horace Trumbbauer, architect, Philadelphia, Pa.
9. Perspective elevations and floor plans of a cottage recently erected for A. P. Dunn, Esq., at Lowere, N. Y. An elegant and attractive design. Cost complete $3,800. Mr. R. H. Duryea, architect, New York.
10. California Midwinter Fair. Half page engraving, showing a bird's eye view, the Mechanic Arts Building; also a view of the Fine Arts Building.
11. Miscellaneous Contents: Damage to water pipes by electrolytic action.—Red slate.—Treating stones for construction.—Metal plated lumber.—Damage by lightning.—Gas from wood.—The steel-clad bathtub, illustrated.—An attractive greenhouse, illustrated.—The band resaw.—The "Grand" fireplace heater, illustrated.—Fly screens, illustrated.—The Norris patent sash pulley, illustrated.—Glutol.—The Ives sash lock, illustrated.—Interior finish of the home.—The Peerless steam and hot water heater, illustrated.—Reproducing architects' drawings.—Cortright metal roofing shingles, illustrated.—A fine metalwork arch, illustrated.

The Scientific American Architects and Builders Edition is issued monthly. $2.50 a year. Single copies, 25 cents. Forty large quarto pages, equal to about two hundred ordinary book pages; forming, practically, a large and splendid MAGAZINE OF ARCHITECTURE, richly adorned with elegant plates in colors and with fine engravings, illustrating the most interesting examples of Modern Architectural Construction and allied subjects.

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Business and Personal.

The charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in the following week's issue

"U. S." metal polish. Indianapolis. Samples free.

Heading machinery. Trevor Mfg. Co., Lockport, N. Y.

Air compressors for every possible duty. Clayton Air Compressor Works, 26 Cortlandt Street, New York.

The Improved Hydraulic Jacks, Punches, and Tube Expanders. R. Dudgeon, 24 Columbia St., New York.

Nickel-in-slot machines perfected and manufactured Electrical supplies, Waite Mfg. Co., Bridgeport, Conn.

Screw machines, milling machines, and drill presses. The Garvin Mach. Co., Laight and Canal Sts., New York.

Centrifugal Pumps for paper and pulp mills. Irrigating and sand pumping plants. Irvin Van Wie, Syracuse, N. Y.

Wanted—2d-hand hand rock drilling machine cheap. Also differential blocks or hoist. Box 124, Montpelier, Vt.

Emerson, Smith & Co., Ltd., Beaver Falls, Pa., will send Sawyer's Hand Book on Circulars and Band Saws free to any address.

Split Pulleys at Low prices, and of same strength and appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

The Carter Pressure Water Filter and Purifier, for hotels, factories, etc. See illustrated adv., page 335. Field Force Pump Co., Lockport, N. Y.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4; Munn & Co., publishers, 361 Broadway, N. Y.

Patent Electric Vise. What is claimed, is time saving. No turning of handle to bring jaws to the work, simply one sliding movement. Capital Mach. Tool Co., Auburn, N. Y.

Patent for Sale—Electrically operated mechanism for feeding and watering live stock. Patented May 15, 1894. See Scientific American of June 2, page 341. Address A. C. Winch, Saxonville, Mass.

Competent persons who desire agencies for a new popular book, of ready sale, with handsome profit, may apply to Munn & Co., Scientific American office. 361 Broadway, New York.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(6071) J. F. F. says: Can you give me a recipe for a hypo-eliminator? I would like something that I would only have to give the negative a few changes of water after using.

A. Peroxide of hydrogen (20 vol.)..... 1 drm.
Water ..... 5 oz.

After washing the negative well it is immersed for a couple of minutes in the solution and again rinsed in water, when the intensification with silver can be at once proceeded with. 2. Where peroxide of hydrogen is not obtainable the following may be used as a substitute, the solution containing that substance in combination with others:

Barium dioxide..... 1 oz.
Glacial acetic acid..... 1 "
Water..... 4 "

Reduce the barium dioxide to a fine powder and add it gradually to the acid and water, shaking until dissolved. A few minutes' immersion in this solution will effectually remove or destroy the last traces of hypo.

(6072) F. R. S. asks for a process for making benzine or turpentine asphaltum from crude coal tar. A. Benzol or benzine is obtained as one of the products of distillation of coal tar. Benzine is a product of petroleum. Wagner's "Chemical Technology," price $7.50, describes the process of distilling coal tar in detail, and illustrations of the stills and refining or purifying apparatus are also given. The process is too complicated to describe by letter.

(6073) B. F. D. writes: What means have been employed to demonstrate that the seven colors of the spectrum when united will produce white? A. You will find some very elegant experimental demonstrations of this fact in "Experimental Science," by George M. Hopkins, $4 by mail.

(6074) F. M. says: Please give a receipt in Notes and Queries for an acid mixture to clean brass gas fixtures, etc. A. The government method prescribed for cleaning brass, and in use at all the United States arsenals, is claimed to be the best in the world. The plan is to make a mixture of 1 part common nitric acid and ½ part sulphuric acid, in a stone jar, having also ready a pail of fresh water and a box of sawdust. The articles to be treated are dipped into the acid, then removed into the water, and finally rubbed with sawdust. This immediately changes them to a brilliant color. If the brass has become greasy, it is first dipped in a strong solution of potash and soda in warm water; this cuts the grease, so that the acid has free power to act.

(6075) E. H. B. asks: What is the board measure feet of lumber in a telegraph pole 30 feet long, 8 inches square at one end, and 4×5 inches at the other? Also the later problem: A column of soldiers 25 miles

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long march 25 miles, so that at the halt the rear man comes to where the front man started from. At the start a courier rides from the rear to the front, and returns to the rear, reaching it (25 miles ahead from where he started) just as the column halted, all movement being at uniform rate. How far did the courier ride? A. Rule for contents of taper timber: To the sum of areas of the two ends add four times the area of the middle section. Multiply this sum by one sixth of the length. If in inches, divide by 144 for board measure. The pole contains 100 feet board measure. The courier rode 42·67 miles to reach the head of the column and 17·68 miles returning to the foot, in all 60·35 miles.

(6076) A. E. R. asks: What must the diameters of the cylinders of a compound engine be, that the sizes of the cylinders will be as 1 is to 4, and the two to have the same horse power as a simple engine with a cylinder 26 inches in diameter, the same pressure of steam in each case? A. The high pressure cylinder should be 18½ inches diameter, low pressure cylinder 36¾ inches diameter.

(6077) J. B. G. says: Can you tell me through the SCIENTIFIC AMERICAN the name of this insect and how to stop its work? A. Reply by Prof. C. V. Riley.—The specimens sent by your correspondent prove to be *Lyctus striatus*, which is the commonest and most widely distributed of our so-called powder post beetles. These beetles and their larvæ are known to live and tunnel in the branches or trunks of dead trees, in telegraph poles, household furniture, wooden handles of tools or agricultural implements, etc. In the case of their emergence from furniture, oviposition has taken place while the boards were still in the lumber yard or while the felled tree was still on the ground. It is also pretty certain that the insects pair and multiply within furniture for several generations, and that only a portion of the beetles issue through the holes bored by them. If a large and heavy piece of furniture, *e. g.*, a bureau, is infested, the destruction of the larvæ and beetles is next to impossible without materially injuring the bureau. The only thing that can be recommended is a liberal and frequent application of common kerosene by means of a rag or a brush. A portion of the oil will penetrate into the wood, through the holes made by the issuing beetles, and will at least kill many of the larvæ and beetles that are still working within the wood.

(6078) W. McC. asks: What flux should be used in soldering copper wires for electrical purposes with soft solder that will not cause the wires to corrode? A. Resin is the best flux for soft soldering for the purpose stated.

(6079) P. J. K. asks: Is there any way to harden steel? For example, plow shares, so that one side is hardened while the other remains soft. A. We call to mind no satisfactory way of hardening the face side of steel plow shares. In attempting to do so the plates are apt to warp and spring out of shape.

(6080) C. W. C.—A solid bar is stronger than a tube of the same outside diameter.

(6081) C. D. R. asks: 1. I would like to know the difference between a dynamo which gives a current of 52 volts and lights 2 sixteen candle power incandescent lamps and one of 110 volts that lights the same number of lamps? A. There is no such thing as a current of 52 volts. A dynamo of given winding may maintain this potential. To increase the potential to 110 volts the simplest plan is to use finer wire and more turns on the armature. 2. When a dynamo is charging a storage battery what prevents said battery from running dynamo as a motor when it has acquired a sufficient current? A. As long as the potential maintained by the dynamo exceeds that which the battery can produce, the battery will take current from the dynamo. If the dynamo is disconnected from the power shaft, the battery will run it as a motor. 3. How can you tell when a Leyden jar is fully charged? A. By connecting to a graduated electroscope and charging until the potential ceases to rise. 4. Would a battery of several rods of electric light carbons and a hollow cylinder of zinc for electrodes, with an exciting solution of sal-ammoniac, give satisfactory results on open circuit work? If not, how can it be improved? A. Yes; but the better plan is to use a very large carbon surface. A single rod of zinc is enough for eight or ten carbons.

(6082) A. H. M. writes: I have three American accumulators, 150 ampere hours capacity each, giving a pressure of 2 volts each. I wish to run a ⅛ horse power 6 volt motor with them with best results as to strength of motor. Is it proper to connect cells in series? How long will cells run motor continuously at full load? A. Connect in series. They will run the motor for ten hours. 2. I wish to charge cells with arc light circuit of 10 amperes. Should cells be thrown into arc circuit in series? How long will it take to charge them? What is the formula for above question? A. You cannot do this with safety. We advise you not to attempt it. Allow 5 amperes charging current for each square foot of positive plate. 3. Is it best to charge them to their full capacity each time they are thrown into the arc circuit, or could they be thrown in and out according to convenience? A. You can work either way. It is best to charge them up to full capacity frequently.

(6083) A. L. J. asks: 1. Please state the object of placing an induction coil in circuit of long telephone lines, since as the E. M. F. increases, the current strength must decrease. A. It gives high voltage for the circuit external to the induction coil. 2. Is the temperature of the electric arc higher than that obtained with largest burning glasses? A. Yes. 3. I ran a current from battery through a short coil galvanometer with astatic needle. After stopping current, the needle did not point north. What was the cause? A. The needle was so perfectly astatic that there was not enough polarity to move it. 4. In the electrolysis of water why do not carbon electrodes succeed instead of platinum? A. Their porousness might make them retain some gas. Iron or copper electrodes in caustic alkali solution are excellent. 5. In electroplating a spoon, for instance, which are the electrodes, the spoon and the piece of metal to be deposited, or the two rods, connected to battery, from which they are suspended? A. The spoon and piece of metal. 6. What are the differences in electromotive force, current strength, and resistance of a circuit in which a motor is included, when the motor is stopped and when running? A. The electromotive force is the same except for the armature, which generates counter electromotive force. If the armature is not allowed to rotate, the current strength increases.

(6084) G. H. S. writes: I have recently constructed a simple electric motor and large bichromate of soda battery described in your valuable book, "Experimental Science." At first 4 cells would run the motor, but after a short time the whole 8 would not work it. I used in solution a saturated solution of bichromate of soda and added sulphuric acid to one-fifth volume. If depolarization is the trouble, why should it depolarize so quick? I never used it half an hour. What is the best way to depolarize? Is it necessary to amalgamate the zincs? Mine are cast and have some blow holes which will not take the mercury. The zincs get covered with a scaly substance which prevents the action of the acid on the zinc. At first the action was so strong that it made the solution quite warm and made quite a strong smell. The solution was a little warm at first. Kindly put me on the right track. A. Your entire trouble is due to bad amalgamation of your zincs. The production of heat and of an odor shows a destructive and useless action and proves that the amalgamation is imperfect. You will have no satisfaction until you attend to this.

(6085) G. M. H. says: Will you please inform me through your Notes and Queries column how to make printing press rollers? A. To 8 pounds transparent glue add enough cold water to cover it; let it stand with occasional stirring seven or eight hours. After twenty-four hours, all the water should be absorbed. Heat it in a water bath, remove from fire, and add 7 pounds molasses that has been made quite hot. Heat, with frequent stirring, for half an hour. The moulds should be clean and greased. Pour into moulds after it has cooled a little, and allow to stand eight or ten hours in winter, longer in summer.

(6086) W. C. C. writes: Will you kindly decide the following dispute? A states that a bullet fired from a rifle straight into the air will reach on its return the point of departure with the same velocity with which it left the muzzle of the gun. B says that possibly this is true in theory, but not in practice, else why will a bullet on being fired from a gun pass through resisting bodies which it cannot penetrate if dropped from a height equal to that attained by the missile when discharged from the gun? A. The theory of the vertical projection of a bullet and its final velocity is derived from the unimpeded speed due to a vacuum and gravity. In practice the resistance of the air impedes the velocity of the bullet in both its upward and downward flight, the return impact being much less than the muzzle impact.

(6087) F. H. F. asks: 1. What is the rule for determining the number of watts necessary to produce an arc light of given candle power? I understand that experts at the World's Fair decided on 450 watts for a 2,000 candle power light, 300 watts for a 1,200 candle power light; now, how can I determine the watts for a 1,500 candle power or a 1,000 candle power light? A. The rule is partly conventional, and is based on experiment. There is no rule. You can approximate by intercalation. 2. What is the relation between candle power and watts in arc lights? A. There is no fixed relation that can be stated. You can deduce an approximation from the above. 3. What book will explain the matter in detail? A. See SUPPLEMENT, Nos. 694, 695, 696, for general articles on the subject; price 10 cents each by mail.

(6088) R. C. F. asks: 1. Will you give me a formula for preventing Ilotype prints from curling up when I do not desire to mount them? A. After washing, dry off the water with blotters, then place the prints in pairs face to face between sheets of strawboard or cardboard, six pairs between each board, and put a weight on top. Let them stand for three or four hours or until dry. Each unmount d print will then remain flat. 2. How can I keep film negatives from curling up after development? A. After the negatives are washed immerse the films for five minutes in a solution of water 1 oz., glycerine 2 minims. When dry, keep under pressure as advised for Ilo print.

(6089) J. McG. asks: 1. Can a copper vessel be used as a generator in the manufacture of hydrogen gas, or is a vessel made of sheet or boiler iron lined with lead preferable, and what should be the thickness of metal to be used in either case? A. By all means use a lead-lined vessel. Burn the joints together—do not solder. No particular thickness is required. 2. Which is the better and more economical method of generating hydrogen, that by sulphuric acid and iron filings in water or by blowing steam through heated coal? A. By the action of steam on coal you produce a quantity of carbon monoxide gas with the hydrogen. By using hot iron borings in place of coal, the steam process will give reasonably pure hydrogen. On the large scale this method is cheaper than the acid generation. 3. Give names of works on subject of generating hydrogen gas for aeronautical purposes, with prices of same. A. See SUPPLEMENT, Nos. 828, 849.

(6090) S. H. Co. write: Parties here wish to procure a magnet that metal buried underground will attract. One which will locate gold or silver. They claim there is such an instrument called "the hidden treasure seeker." Is there such an instrument manufactured, and if so, can you tell us where one can be procured? A. No such thing exists. [It is surprising that any one should expect to be able to buy apparatus of this description. If there are $10,000,000,000 worth of treasure hidden in the earth, what would be the value of an instrument that would indicate its whereabouts? And who, owning an instrument of this kind, would part with it for any consideration whatever? The fact of offering for sale an instrument purporting to be an operative instrument for this purpose is *prima facie* evidence of fraud or dense ignorance. The shovel and pick, the hammer and drill, are the only treasure-seeking instruments of any value. Ore finders, divining rods, and devices of that class are delusions.—EDS.]

(6091) J. M. W., Cal., writes: Would you kindly let me know if the following is correct? In the Encyclopedia Britannica (Americanized edition, Belford-Clarke, publishers, Chicago, 1890) it states under the heading of "weights and measures" that the United States inch=1·000049 British inches? I always thought they were identical, and that Whitworth's standard in measuring was the same in both countries. Again, in an English work I see the grain apothecaries' weight= 1·0978 grains avoirdupois, in other words, 10 grains apoth. =nearly 11 grains avoir.; in the above encyclopedia there is no difference given. Is there any difference? In coming across such discrepancies as the above, it makes one ardently hope that something will soon be done toward bringing about a "universal standard system of weights and measures." Would you mind also stating the difference between the English and American pint, quart, peck, and bushel? A. The difference in length of standard measures as stated is correct. Brown & Sharp Manufacturing Co. use the American standard. The grain has but one value, 7,000 to one pound avoirdupois or troy, in England. In the United States 7,000 to one pound avoirdupois and 5,760 to one pound troy and apothecaries' weight. The American standard measure of the gallon is 231 cubic inches. The British standard gallon is 277·274 cubic inches. The United States standard bushel is 2150·42 cubic inches. The imperial or British bushel is 2218 192 cubic inches. Divisional measures in proportion. The metric system is intended to equalize international weights and measures.

(6092) G. E. K. says: Would you please give the formula and instructions for mixing same for making Portland cement walks, drives, floors, etc.? I notice some are of a fine gain and others of a coarse nature. Also of different colors. Please explain this feature. A. English Portland cement is generally preferred. Procure a sharp, light-colored sand, and wash it free from all particles of soft earth or soil; also some stone chips, gravel, and large stone. Excavate the sidewalk about 18 inches deep, and fill in the large stone to within 6 inches of the surface; prepare a concrete made of the cement 1 part, stone chips and gravel about 6 parts, and bed it in upon the stone bottom to within 2 inches of the surface; then prepare a concrete of the cement 1 part and fine sand 2 parts, and lay it in up to the surface, floating the surface with the cement at pleasure. Finish by lining off into very regular blocks. A more economical sidewalk can be made by omitting the stone bed, but it will require a good hard soil to lay it on, and then will not be so sure of being permanent. See also SUPPLEMENT, No. 539. Sometimes finely broken stone is used in place of sand. The color can be varied by the use oxide of iron, such as is used for metallic paint.

(6093) F. L. M. says: How should whitewash be prepared to secure best permanent results on cellar walls? Painters affect entire ignorance in the matter, and the information is difficult to obtain. A. The following coating for rough brick walls is used by the United States government for painting lighthouses, and it effectually prevents moisture from striking through: Take of fresh Rosendale cement, 3 parts, and of clean, fine sand, 1 part; mix with fresh water thoroughly. This gives a gray or granite color, dark or light, according to the color of the cement. If brick color is desired, add enough Venetian red to the mixture to produce the color. If a very light color is desired, lime may be used with the cement and sand. Care must be taken to have all the ingredients well mixed together. In applying the wash, the wall must be wet with clean fresh water, then follow immediately with the cement wash. This prevents the bricks from absorbing the water from the wash too rapidly, and gives time for the cement to set. The wash must be well stirred during the application. The mixture is to be made as thick as can be applied conveniently with a whitewash brush. It is admirably suited for brickwork, fences, etc., but it cannot be used to advantage over paint or whitewash.

(6094) E. E. D. asks: I have four 1·2 inch horse shoe magnets. How can I recharge them? A. By touching the poles to the poles of an active dynamo and removing it slowly in the line of the armature axis you can recharge a magnet. Be careful to touch the right poles, *i. e.*, north pole of magnet to south pole of field and *vice versa*. 2. How can I make a magneto exploder with these magnets? A. See our SUPPLEMENT, Nos. 161 and 315. 3. How can I make an atomizing petroleum burner? A. See SUPPLEMENT, No. 569.

(6095) F. R. H. says: Can you tell me through the Notes and Queries column of your paper how carbon paper is prepared? A. Melt 10 parts lard, 1 part of beeswax, and mix with a sufficient quantity of fine lampblack. Saturate unglazed paper with this, remove excess and press.

(6096) W. T. says: Would you please give me a formula for a cement that I can cement brass ornaments to glass so they will stick tight? A. A cement for such purposes as fixing metal letters to glass windows consists of copal varnish 15 parts, drying oil 5 parts, turpentine 3 parts, oil of turpentine 2 parts, liquefied marine glue 5 parts. Melt in a water bath, and add 10 parts dry slaked lime.

(6097) W. T. writes: I have built the 8 light dynamo contained in SUPPLEMENT, No. 600, and must say it is a dandy. Have not had the least trouble with it. I made all connections and started it without any batteries, and it lit three 52 volt 16 candle power lamps at once. I have also made the hand power dynamo, and had no trouble with it. Is there a SUPPLEMENT treating on volt or ampere meters? If so, what numbers? A. Ammeters, SUPPLEMENT, Nos. 440, 603, 618, 628, 734; voltmeters, SUPPLEMENT, Nos. 353, 552, 556, 668, 734, 933.

Communications Received.

"On a Display of Aurora Polaris." By A. W. F.
"On the White Heron." By T. H.
"On Slow Beating Pendulums." By C. R. S.
"The Great Sugar Pine." By T. H.

TO INVENTORS.

An experience of forty-four years, and the preparation of more than one hundred thousand applications for patents at home and abroad, enable us to understand the laws and practice on both continents, and to possess unequaled facilities for procuring patents everywhere. A synopsis of the patent laws of the United States and all foreign countries may be had on application, and persons contemplating the securing of patents, either at home or abroad, are invited to write to this office for prices which are low, in accordance with the times and our extensive facilities for conducting the business. Address MUNN & CO., office SCIENTIFIC AMERICAN, 361 Broadway, New York.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Granted

June 5, 1894,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Acid by means of heated gases, apparatus for concentrating sulphuric, J. L. Kessler 520,994
Advertising apparatus, A. Berliner 521,009
Alarm. See Burglar alarm.
Amalgamating machine, gold, P. E. Gaffron 520,847
Amalgamator, G. Delage 521,145
Ammeter, E. R. Knowles 520,963
Animal trap, Roberts & Owen 520,804
Annunciator, T. J. Thompson 521,144
Annunciator, electrical, F. W. Ross 521,046
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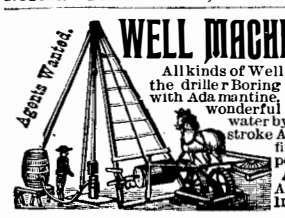

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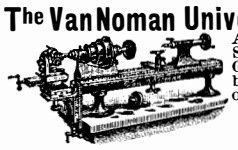
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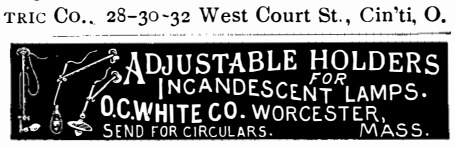

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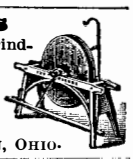
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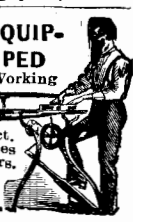
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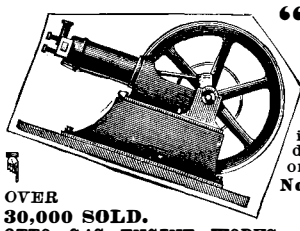

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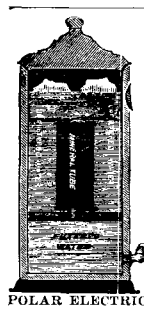

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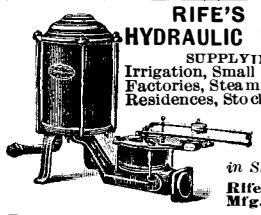

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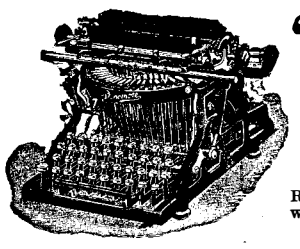

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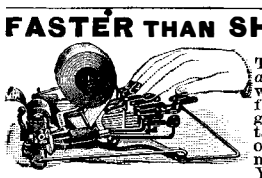

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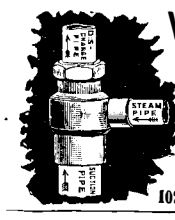

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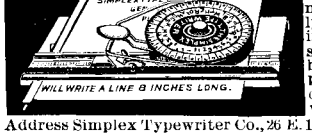

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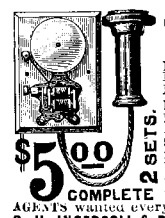

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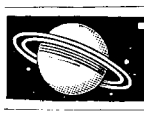

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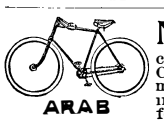

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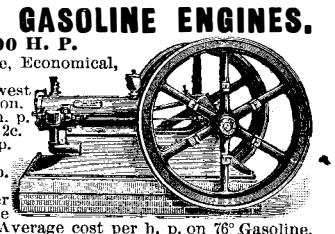

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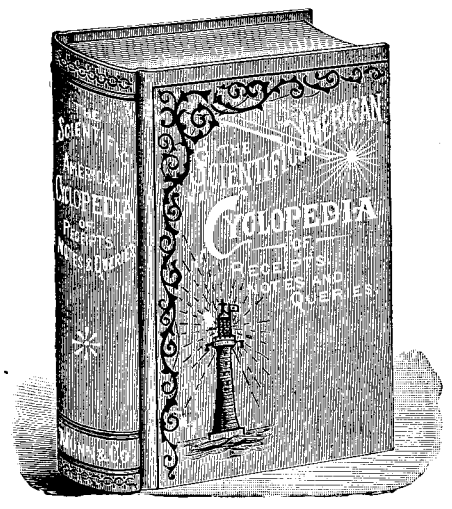

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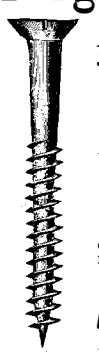

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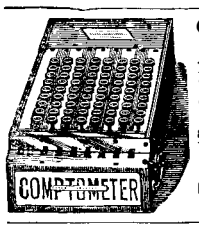

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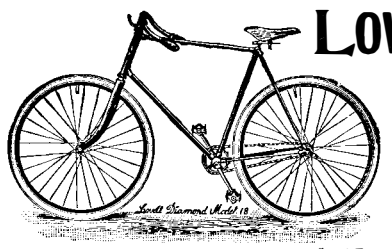

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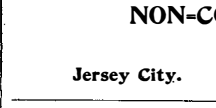

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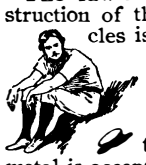

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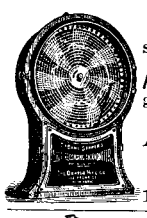

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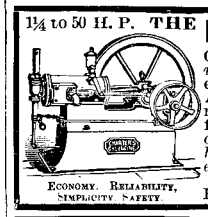

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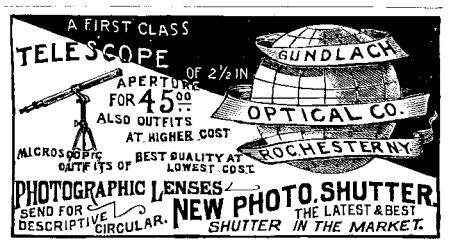

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